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THE telegraph brings intelligence of the death of George Godwin, the well-known architect, and until within a few years the editor of the English *Builder*. Mr. Godwin was born near London, in 1815. He received his professional training in the office of his father, who was an architect of reputation, and practised with success in London. Early in his professional life he had found amusement in writing, not only on technical but on lighter topics, and in 1844 he became the editor of the *Builder*, which he managed with extraordinary success for forty years, resigning it at last when advancing age made it necessary for him to give up a portion of his work, into the able hands of Mr. Statham, the present editor. Under him the *Builder* was perhaps the most popular and most frequently quoted technical journal in Europe, and the opinion of its editor was anxiously sought on nearly every professional subject. The universal respect and regard which Mr. Godwin enjoyed among architects was shared by a large portion of the public, his zeal for his art, and his activity in promoting its interests, bringing him into relations with a great many persons of all classes. The movement for the establishment of the famous Art Union of London was greatly aided by his efforts, although, at the time of the incorporation of the association, he was but an enthusiastic young man of twenty-four. Later in life he became deeply interested in the improvement of the habitations of the poor. Every reader of the *Builder* will remember the importance which was given to the subject in its pages, and its editor became one of the best living authorities on lower-class dwellings. If we are not mistaken, Mr. Godwin, in giving up the control of the *Builder*, intended to devote a part of the time which he thus gained to a more thorough study of this important matter, and his death, at a time when his knowledge and experience might have been most useful, will be felt as a serious loss among those who endeavor to ameliorate the condition of their fellow-men by work, and not by oratory.

THE *Société Centrale des Architectes de Belgique* appointed, not long ago, a commission to study the question of architectural competitions, and see if something could not be done to make them more attractive to the best men in the profession. The subject is not, it must be confessed, a particularly new one in meetings of architects, but the Belgian committee succeeded in handling it in a style altogether novel, and has made some suggestions which are well worth considering. Finding, or more probably knowing beforehand, that most architects believe the judgments on competitions to be given so much at random that there is little credit in engaging in them, even for those who win the prizes, the committee says that it has concluded that a system of points would best meet this objection to the present methods of judging. Supposing, for example, that to the expressions "very bad," "bad," "passable," "quite good," "good," and "very good," are allotted values of one, two, three, four, five and six, respectively, zero standing for the absence of a drawing; and supposing, again, that the relative importance of the six drawings, and the written description required in a given competition, is rated by allowing twelve points to each of the two floor-plans, eighteen points to the elevation of the principal front, twelve points to the side elevation, twelve to the section, twelve to the detail sheet, and six to the written description, with these data an excellent and perfectly fair comparison of the different sets of designs can be made by judges of comparatively little skill as experts.

TO illustrate this by an example, we will imagine that four designs have been submitted in competition by Messrs. A, B, C and D. The first member of the jury finds A's entrance floor plan very good, which counts him twelve for that item. The second-story plan, on the contrary, is only passable, and as this adjective is worth only half as much as the expression "very good," and as twelve is the maximum mark for a floor plan, A gets for his only a mark of six. The front elevation is "quite good," and, by the same process of arithmetic gains for its author a mark of eight. The side elevation is "good," and is therefore worth ten; the section is "very good," and gets twelve; the detail sheet gets eight in the same way, and the description five. Each member of the jury marks independently of the rest, and at the end of their examination their marks on each design are added together and divided by the number of members, and the quotient recorded as the official mark of that design. When all are judged, the premiums are allotted in the order of the marks, and here a further improvement upon the ordinary plan is suggested. Instead of announcing arbitrary premiums, it is proposed that the whole sum appropriated for premiums should be divided between the first two or three competitors in proportion to their marks. Thus, suppose A in our imaginary competition to have gained sixty-eight marks in all, after averaging the points assigned him by the different members of the jury, while B has in the same way obtained seventy-four points, C, fifty-one points, and D, fifty-five. There are to be only three prizes, so that A, B and D will alone be entitled to share in them, and the total prize money, which we will suppose to amount to sixteen hundred dollars, is to be divided in the proportion of the marks of each candidate. B, therefore, who had a mark of seventy-four, will get six hundred dollars, in round numbers, A, five hundred and fifty dollars, and D, four hundred and fifty; while C, who has obtained more than half the possible highest mark, is comforted with an honorable mention. By this means the reward of each of the ablest competitors will be somewhat proportionate to his merits, and a man who may be only a hair's-breadth inferior to another will have this fact certified by receiving a compensation nearly equal to that of the other, instead of being sent off with a ridiculously small portion of the premium allotted to one whom the turn of a hair, almost, might have caused to change places with him. Novel as this plan for conducting competitions seems, we quite agree with *La Semaine des Constructeurs*, from which we borrow the description of it, that if the associations of architects wished they could easily obtain the general adoption, either of it or of a similar one. Unlike most of the schemes of competition presented by architects, this commends itself as much to the laity as to the members of the profession. Most men desire to be fair in judgment, and know well enough that the last plan presented in competition is apt to upset all their previous ideas, and carry off the prize; and a system of marks, by which they could judge deliberately, and to a certain extent intelligently, and would be in no danger of being continually distracted by the new beauties unfolded by each successive design that they came to, would be regarded as an excellent thing. The averaging of the marks of the jury would obviously tend also to correct individual prejudice, and the distribution of the premiums in proportion to the final marks could not be objectionable to the lay promoters of competitions, while it would tend greatly to attract good architects, and this is what all decent promoters of competitions want.

FOR some months a portion of the Grand Opera in Paris has been lighted by incandescent electric lamps, put in by the Edison Company in January last, on a six months' trial. The trial having proved satisfactory, the lamps, with the machinery and apparatus for producing the light, have now been accepted by the management of the Opera, and gas will probably never be used there again after this year. Even the huge "lustre," the heavy but gorgeous chandelier which hangs in the centre of the auditorium, is fitted with electric lamps in place of gas jets, much to the advantage of the portion of the audience which occupies the upper tier of seats. *Le Génie Civil* gives a description of the apparatus used for furnishing the light, from which it appears that the motive power consists of a Corliss engine, of three hundred horse-power, with a fly-wheel sixteen feet in diameter, making sixty-five revolutions per minute, multiplied at the shaft to two hundred revolutions per minute. This is supplemented by an Armington & Sims high-speed engine, of one hundred horse-power, making three hundred revolutions per minute without a fly-wheel, which is to be used only when the larger engine is out of service. These engines drive three dynamo machines, and two others are kept ready in case of emergency. Lamps of two kinds are used, most of them being of the sixteen-candle sort, but ten-candle lamps are used in the great chandelier, and a few, of thirty-two candles, are placed on the grand staircase. Altogether, seventeen hundred incandescent lamps are in regular use in the public portions of the theatre, and the *loggia*, or open balcony in front of the great foyer, is provided with eight arc-lights. The seventeen hundred incandescent lamps of the auditorium replace twenty-two hundred gas-jets, burning about twelve thousand cubic feet of gas per hour, and discharging perhaps a hundred thousand cubic feet of products of combustion into the air during the same period, and as the ventilation of the Opera at ordinary times is none of the best, according to our notions, it may be imagined that the frequenters of the theatre applaud the change. As we observed the lighting, a few months ago, it appeared to be managed with remarkable skill. The turning-down of the light, which is difficult with any electric lamps, but is indispensable in the case of theatres, was very successfully done, and it is probably for this reason that the directors of the Opera, in concluding their contract with the Edison Company, have resolved to substitute electricity for gas on the stage, as well as in the auditorium. The stage, with the dressing-rooms and work-rooms, all of which are now included in the contract, will need many more lamps than the auditorium, and the final installation will comprise six thousand one hundred and seventy-six incandescent lamps, all of which will be of ten-candle power except the eleven hundred sixteen-candle lamps, and the twelve of thirty-two candles, which are already in service in the auditorium and vestibule. These lights will replace seven thousand five hundred and seventy gas-jets, which includes the whole number in the building. With the consent of the police authorities, even the safety lamps in the corridors and about the theatre, which are, in all modern theatres, provided with an independent supply of gas, or even of oil, so that they will not be extinguished in case accident or panic should lead to the turning off of the main lights, are, in the Opera, to be replaced by incandescent lamps, fed from four great storage batteries, so placed that any two might be destroyed without extinguishing the light.

SOME years ago the Bell Telephone Company made a few experiments, in the course of which the operators had occasion to observe the effect upon the telephone signals of the currents passing through neighboring telegraph wires. It was found that if a telephone wire ran along one side of a street, and an ordinary telegraph wire on the other side, the Morse signals on the telegraph wire could be distinctly read in the telephone instruments. This was at the time thought quite surprising, and when the Bell experimenters subsequently asserted that on one of their wires, which ran through a quiet country district, they could hear the peculiar signalling of the American Rapid Telegraph Company's system, although the nearest of the American Rapid wires was five miles away from their line, they were hardly believed. Now, however, it is proved by experiments made expressly for determining this point, that signal currents are communicated from wire to wire at far greater distances than this. At the time of the Bell Company's trials, the American Rapid Telegraph was operated by means of a very powerful battery, and the currents transmitted through the wires were many times more intense than those of the ordinary systems, and would naturally be perceptible at a greater distance; but Mr. Preece and his friends in England have found that even with the ordinary Morse instruments, and the batteries commonly used with them, signals on one wire could be distinctly heard on another forty miles away, the two wires having no medium of communication more direct than that furnished by the earth or the air between them. To make sure that no mistake had been made in the experiments, a special commutator was placed on one of the wires, which, instead of sending the ordinary Morse signals, transmitted regular impulses, so rapidly as to produce a musical sound. By varying the rapidity the pitch of the sound was made to rise and fall, and this unmistakable sound, on putting the apparatus in action, was distinctly heard in the telephones connected with the other wire. To determine whether the communication took place through the earth or the air, Mr. Preece and his companions made two distinct and complete circuits of insulated copper wire, laid on the ground. The circuits were about a quarter of a mile in diameter, and nowhere approached each other within a quarter of a mile; yet conversation was so readily carried on between telephones connected with the independent circuits that it appeared to the experimenters probable that the distance might be much increased without making the signals so faint that they could not be understood. As another illustration of the possibilities of transmission of electric currents, without metallic conductors, it is said that not long ago, when the telegraph cable from England to the Scilly Islands was broken, signals made at the shore end of this cable were read on the receiving instruments of another cable, crossing the Channel to Brest, and lying nowhere within half a mile of the Scilly Island line.

THE *British Architect* of October 15 contains an admirable obituary notice of Mr. E. W. Godwin, one of the best architects in England, who died on the sixth of the month, at the age of fifty-eight. Mr. E. W. Godwin, who must not be confounded with Mr. George Godwin, lately the editor of the *Builder*, who, as we mention elsewhere, died about two weeks later, will long be remembered, in connection with Waterhouse, Burges, Street and Scott, as one of the ablest leaders of the modern school of English architecture. In his tastes, and treatment of the problems presented to him, he resembled Burges more, perhaps, than any of the others, but although perhaps less original than that extraordinary genius, he surpassed him, to our mind, in dignified and well-studied composition. In fact, the most striking characteristic of his work was the perfection with which it was studied, and the beauty which, by that means, he was able to obtain simply by the distribution and proportioning of openings, and the position of string-courses; and in this art, which of all others, perhaps, requires the highest mental power, he had, as we think, no rival in England. Such work as he wished to do, however, requires much time as well as thought, and of late years he had found it advisable to turn his attention to a lighter class of design. At first, like his friend Burges and several other architects of talent, he devoted himself to furniture, and most of our readers know the quaint and pretty devices which he produced so easily. Later, however, he became interested in the decoration of theatres, and theatrical scenery and costuming, and soon found constant employment in this sort of design, which he succeeded in nearly revolutionizing. At first he contented himself with arranging costumes for certain plays which interested him, and as this led him to study the archæology of his subject, the scenery and stage-setting came to be included in his ideas, and were placed under his control, until he became one of the most important factors in the production of several plays which won very great success; the best known, perhaps, being the famous "Claudian." In the midst of this work, the hurry and excitement of which perhaps overtasked his nervous strength, his vital powers failed, and he died in the prime of his intellectual capacity, leaving a name which, by the few who knew him intimately, will be cherished as that of one of the most thorough artists of his time. Among students of architecture, to whom he was always kind, and for whom he wrote most instructively, he will be remembered in a different, though not less pleasant way, and we hope that for their benefit some of his admirable criticisms and suggestions, together with as many as possible of his beautiful designs, may be collected and placed within their reach.

ORIGIN OF MALARIAL EPIDEMICS.[1]

Old Chair in the Pilgrim Hotel, Provincetown, Mass.

THE modern theories of the etiology of diseases, and especially the germ theory, must compel us to recast our views of the origin of malarial fever.

Whoever pretends that malaria arises *de novo* from the conjunction of heat, moisture and vegetable decay, although supported by the evidence of competent observers in many countries, and by the great weight of authority of the best medical and sanitary writers, who recognize these three as essential factors, must encounter many strange and inexplicable contradictions, and find himself compelled to show, not that under certain conditions of soil-moisture and temperature malaria had undoubtedly arisen, but to explain why, under precisely similar conditions in countless instances for a long series of years, it may be a century, this disease has been unknown in localities where it has suddenly appeared as an epidemic.

On the other hand, he who denies, *in toto*, that these three factors have any agency whatsoever in the etiology of ague, is forced to admit that his chief arguments are based upon exceptions and negations, and that a single positive fact may scatter them to the winds.

It is believed by the writer that the epidemic at Framingham offers an unexampled opportunity for the study of the natural history of malaria.

The connection of intermittents with the erection of dams, especially upon winding streams, having broad margins of meadow and wooded swamps, where the flow is impeded and the water becomes stagnant and the land "drowned" — this connection is well known; while instances are numerous enough not to require citation, where, not only in other countries and along our western rivers, but here in New England the disappearance of malaria has been with undoubted justice attributed, not to time alone, but to the removal of dams and obstructions, and the draining and cultivation of wet lands.

It is unnecessary to quote the opinions of writers, sanitary and medical, upon this point. We must admit the value of such testimony. But in order to narrow the question somewhat, and to give this paper a local character, a table is annexed showing the views entertained by the various observers of previous epidemics in Massachusetts, taken from the admirable essays on this subject of Drs. Holmes and Adams, to which reference has been already made.

We will now pass to a consideration of the conditions in Framingham.

At the close of the year 1874, the city of Boston decided to take the Sudbury River as an additional water-supply, and for this purpose began the work of excavating for three large dams upon that river and one of its principal tributaries, called Stony Brook. Soon after, work was begun upon a conduit from Farm Pond to Chestnut Hill Reservoir. In constructing the dams, the river was diverted and its old bed laid open to the sun and air. Great quantities of alluvial mud were exposed and dug up in every direction. The excavations for the foundations of the dams were deep and extensive, long wings being required by the porous nature of the soil. This work was chiefly done in the summer. The foundations were in some cases twenty or thirty feet in depth. The men who performed this work lived in miserable barracks or shanties, temporarily put up as near to the places of labor as possible. They drank the water of the more or less stagnant river, and passed their days and nights in the midst of its mud and fogs.

The Chestnut Hill Conduit was constructed directly through and upon the meadows supposed to be the seat or nidus of the malarial infection of the epidemic of 1885. Here again very extensive upheavals and removals of muck and marsh deposit were made, it being necessary to find below the ooze a solid basis upon which to build.[2] The peat and mud were removed from the whole width of the cutting and replaced by gravel, or when no firm bottom could be reached, as happened in parts of Guinea Meadow (the swamps in question), piles were driven and planking laid. A more extensive and thorough turning up of wet and decaying vegetable matter (more or less mixed also with the sewage of the neighboring village, which gravitates to this meadow), it would be difficult to conceive of.

Several hundred men were employed upon this construction, there was quite a numerous population in the territory north of the line, and scattered houses in every direction. Much of the work was done in the summer, the time of draught and small rainfall, when the water was lowest in the meadows. These are drained by Beaver Dam Brook, a sluggish, obstructed stream, having a slow water-shed of three thousand acres.

Here then were present in the highest perfection in the precise locality of the epidemic of 1885 in South Framingham, the conditions assigned as the probable cause of malaria in certain reported cases in Massachusetts, besides numberless instances in this and other countries where epidemics have been attributed, by competent observers, to digging and removing the soil in the construction of streets, sewers, etc., etc.

The Tomb of Theodoric, Ravenna, Italy.

All the work above described was completed at least *seven years before* the epidemic appearance of intermittent fever in Framingham.

The summers of 1870 – 1871 were periods of drought and low wells, and also those of the years 1877–78–79–80, and especially 1883, when the total fall of water in June, July, August and September was only about half that of 1882 and 1885. This condition has been cited by some observers as having a connection with malaria.

Much of the picturesque beauty of Framingham, for which it is so justly celebrated, is due to the many pieces of water which meet the eye at every turn. Besides the larger lakes and the river Sudbury, which winds through the middle of the town from the southwest corner to the northeast, there are numerous smaller ponds, streams and brooks; some of the latter being winding and stagnant, others rapid and quick. These, in spring freshets are apt to rise and overflow their banks and cover the meadows in all directions. Several times within the memory of the writer, such a freshet has occurred upon Stony Brook and the Sudbury River and their tributaries, tearing away culverts and roads, choking up the natural drainage of meadows with vast quantities of gravel and silt, and leaving behind pools of stagnant water, which, having no outlet and escaping chiefly by evaporation, remained green, slimy, and festering far into the summer. In the end of March, 1876 (the year of the commencement of the work of construction of dams by the City of Boston), such an overflow took place. This condition has been assigned frequently as one of the contributory causes of the epidemics of malaria.

In 1872 Lake Cochituate became very low, and in order to draw water into it from Farm Pond and the Sudbury River, a connection

[1] Portion of the report by Dr. Z. B. Adams on "Malaria in Eastern Massachusetts" in the Supplement to the Seventh Annual Report of the State Board of Health, Lunacy and Charity of Massachusetts.

[2] In one case the mud was removed to a depth of twenty feet.

was made by means of an artificial ditch or canal discharging into Beaver Dam Brook, which was, however, abandoned the next year. It was again opened in 1875 and used until 1878, when the connection with Farm Pond was completely severed, and, the brook being obstructed, this canal became stagnant and has since remained so. It receives the drainage of perhaps forty houses, and its wooden sides have fallen in. It is especially in the vicinity of this stagnant ditch that malaria has been rife during the epidemic. It is proper to remark that this condition of things has been in existence since 1879. Of variations purely atmospheric there is little to say. The mean summer temperature of 67°–68° remained unchanged in 1885. In the months of August [1] and September the days are apt to be very hot and the nights cool, damp and foggy, especially in low grounds and near streams or meadows. The Guinea Meadows contained rather more stagnant water than is usual throughout the summer, in 1885, but the difference was not material. The rainfall during the last days of July and in August of that year (the time of especial prevalence of malaria), was unusually great — 7.34 inches in thirty days. If this had any effect whatever, such a rainfall must have acted, we should suppose, to abate the epidemic influence. The interesting fact is noted, however, that on the days immediately succeeding a heavy rain an increase in the number of fever cases was observed, suggesting a direct connection of cause and effect.

But it is preëminently in and around the reservoirs and dams of the Boston Water Works that those precise conditions prevailed which are assumed to have direct association with the origin of malarial epidemics. Saturation of soil and vegetable decay, foul exhalations and effluvium arising from organic matter decomposing in connection with heat and moisture, the effect of the sun upon "drowned lands," associated usually with the presence of dams and artificial reservoirs of water, these are suggested or referred to in some way or at some time, in explanation of the appearance of intermittents in twenty-five of the thirty towns enumerated in the accompanying table.

In Framingham, as has been already said, about 850 acres are occupied by these reservoirs. The town covers say 14,000 acres, of which more than half, being on a much higher level, we may assume to be beyond the reach of any malarial influence arising from this source. About one-eighth, then, of the area of the town liable to be affected, whether by soil-water or by exhalations from these basins, is covered by the flowing of the reservoirs when the dams are closed. The Sudbury River watershed is much of it low and covered with wood and bog, and, when raised, the water covered lands which had been farmed and manured for a century. The water had always a yellow color and a pondy taste in consequence.

In 1878–79 the wood was cut and the brush removed, leaving, however, large areas of swamp, covered with stumps and muck, to await the slow processes of chemical change. The dams were completed and the basins allowed to fill. In 1881, during the late summer, the season having been a very dry one, Basin Number 3, containing by far the largest area of flowage, fell so as to expose one-half or two-thirds of its surface, which was largely composed of swamp, covered with rotting stumps of trees, black mud and decaying vegetation. The peculiar effluvium of "drowned land" was almost insupportable in its vicinity. This had been submerged more or less constantly for more than two years. A rank vegetation of fungi and sphagnum appeared. Marsh gas could be seen bubbling up in the stagnant pools. The same condition of things again occurred in 1883, after two years' submergence. In this latter case everything was exposed except the bed of the original stream.

In Basin Number 2, in 1883 and 1884, after four or five years' submergence, the water was drawn down in the same thorough manner, and much work was done in clearing out the mud from the bottom, filling up "dead ends," etc. Large quantities of muck were removed and placed upon the shores.

Basin Number 1, of very shallow flowage, was often very low and smelled badly, but was never drawn so completely down as the others. The water in the gate-houses gave out a strong sulphuretted-hydrogen smell at all times.

Farm Pond was drawn down seven feet in 1881, and a temporary ditch or channel was made around its edge, connecting the conduits independently. At that time its water had the "cucumber" taste already spoken of, and was offensive to the smell. "Professor Ira Remsen, of Baltimore, attributed the objectionable taste to the presence of a species of fresh-water sponge, which was found in small quantities on the gravelly or stony parts of the bottom of the pond." "After a short time the bad taste in the water of the pond disappeared." [2] In 1884, Farm Pond was drawn down two feet, and in 1885 four feet, in order to construct the new conduit marked upon the map, and the southwest portion, being nearly cut off from the rest of the pond, became covered with a rank growth of grass and weeds. There was, however, no complaint of any foul odor from this pond during 1885.

In Basin Number 3, in 1879 (the year of first flowage), the water was contaminated by a growth of minute algæ, similar to that found in the Mystic River supply. The temperature of the air was high at the time of its appearance, and that of the water especially so, occasionally being even warmer than the air, and this at a depth of twenty feet, which, of course, suggested chemical action as its cause.

[1] August, 1885, was exceptionally cold.

[2] "Additional Supply from Sudbury River," by A. Fteley, Resident Engineer, Boston Water Works, Boston, 1882,

Speaking of these algæ, Mr. Fteley says: "these minute plants, which appear to be uniformly distributed throughout the water, flow with it, and are of such small bulk that they cannot be separated by screens; the wind has a noticeable effect on them, and often blows them towards the lee shore, where they accumulate and form a solid scum of a sharp green color. When in the fresh state, they emit a very peculiar musty odor; if stranded by the action of the wind they soon decay and form a bluish-green mass, which develops a smell as of organic matter in the process of decomposition. Of the formation of the algæ, or of their origin, little is known; but it is remarkable that they appear very suddenly, and in large quantities; shallow flowage, it is said, favors their development, probably on account of the higher temperature which the water attains in such conditions when heated by the sun; but they are formed very rapidly, also, in deep water. I have observed several times that large quantities appeared in a very short time equally distributed through hundreds of millions of gallons of water, twenty feet deep, several hundred feet from any shore, and in very calm weather. . . . The formation of the algæ appears to follow the temperature of the water, increasing and diminishing with it."

These algæ appeared in Basin Number 1 in 1880, but have since nearly or entirely disappeared.

It is only necessary to add to the above description, that the peculiar sickening effluvium arising from the decay of these minute organisms was distinctly perceptible in the air at a considerable distance from the reservoirs.

It seems unnecessary to follow this vein of investigation any further. It suffices to say, that for nine years the three factors of heat, moisture, and vegetable decay, which, it is assumed, can *de novo* produce malaria, have been present in the greatest activity in Framingham, while none, or rare and doubtful cases of intermittent fever have arisen; whereas, in the summer of 1885, during an epidemic of the disease, few, if any, cases appeared in the vicinity of the great reservoirs and dams, where the three factors had been present in the highest degree.

But, on the other hand, to deny *in toto* the agency of heat, moisture and organic decay in the development of malaria is to utterly reject the evidence of experience and observation. The germ theory enables us to reconcile these conflicting opinions.

All organic life requires these three elements for its growth and propagation, and the higher the development of the organism, the more of these it requires. Hence we may conclude that the malarial germ is a living thing and somewhat highly organized. It cannot be simply chemical, nor magnetic, or telluric. That it differs essentially from the so-called zymotic ferments may be assumed from the fact that in the human organism a first attack does not procure immunity from a second, and that certain races of men, as well as certain individuals, show little susceptibility to its influence. Its natural history, too, seems to be more open to study and observation than that of most of the germs of infectious diseases.

It would appear that the malarial germ requires stagnant water for its growth and development. It will not live in running streams, nor in large moving bodies of water. If you drain the water from the swamps where it exists, and cultivate, that is aerate, the soil, you destroy the germ. You do not draw it into a new location, you kill it outright. Whether this results from mechanical or from chemical causes we will not stop to inquire.

The germ has a certain weight and size; it obeys the laws of gravitation, is blown about by winds, and is stopped by obstacles. It requires a certain temperature, and is benumbed, possibly killed by cold. It is true these statements admit of question, but they are not mere assumptions. They are gathered from the study and observation of a host of facts, collected by competent scientists.

As to the question of the spontaneous disappearance of malaria, this, like its epidemic appearance, we cannot explain; but the same is true of all the germs of epidemic and zymotic diseases, which present this characteristic. A detailed account has been given above of the sudden appearance and disappearance of the anabœna, a species of algæ, in the water of the reservoirs. Here is an organism of easy identification, found swarming in the water, and then going out of existence, unaccounted for, without known origin or cause, its only condition of existence being a rather high water temperature. A similar, but not identical, growth has been discovered in another artificial reservoir many miles away, and having no known connection with the Sudbury basins. Many grosser pests, familiar to agriculture, have this character of periodicity of appearance and disappearance, among which may be cited the seven-year locusts, the canker-worm, the blight, the rose-bug, and many others.

By what avenues is the malarial germ introduced? Two methods suggest themselves; namely, rain-storms and underground-water. Malaria is supposed to rise and be carried to and fro in fogs and mist. This may account for its introduction through the medium of clouds and rain. Thus may occur those occasional appearances of malaria upon high ground far removed from any swamps or meadows.

But the underground movement of water is a factor which has not, perhaps, been sufficiently considered in this question. How often can we know the source of water in deep wells? Many wells are known to remain full in long droughts, or to fill suddenly without the actual presence of rain-storms. There are springs in this country, called "barometric," that, running dry, burst forth and flow in full volume many hours before any rain is seen to fall in their immediate vicinity. Whence comes the head of water, unless it be

a fall of rain which has saturated the earth and reached the underflow at some considerable distance away?

What do we know of the extent of the substratum of quicksand of varying depth and full of water, found everywhere, it is believed, in Framingham, and extending indefinitely beneath the soil in the adjacent towns? That this is something more than an underground lake of vast extent is very probable. It is believed by many that this water has a certain gradual and imperceptible flow. Whence and whither, we cannot say.

Professor Cantani[1] believes that the malarial parasite enters into the blood more frequently by way of the stomach than by the respiratory tract; that drinking water is the vehicle of the infection more surely than any other means. It is uncertain if it ever enters by the air alone. He suggests, also, that vegetables or fruits which ripen upon the ground may introduce it into the human stomach in some cases.

There are occasionally cases of ague whose etiology is so obscure that none of the explanations here offered can make it clear. They may serve as examples of exception to the rule.

In the epidemic in Framingham there was no case which furnished an atom of evidence to show that the disease was communicated by direct infection or contagion from one individual to another.

The truth, long suspected, now so generally accepted, that malaria, like other infectious diseases, never arises spontaneously, but that the introduction of a germ is necessary, is affirmed. That this germ is a living organism, capable of development under certain conditions of heat and moisture, and of propagation within the body, where it produces the phenomena of chill and fever, then dies and is eliminated, is probable. The theory seems well founded that in the healthy individual this may be the end; while, in many cases, some of the germs remaining uneliminated, propagate again within the body, and thus, after a certain number of hours, produce a recurrence of the ague fit.

The opinion is held that germs once introduced may remain dormant within the human body awaiting favorable conditions for development or propagation.[2]

During the winter of 1885–6 some of the chronic manifestations of malaria appeared, a few being in individuals not known to have had chills and fever, and in March, 1886, the disease began to show itself among those attacked during the preceding summer, and also a few new cases were seen.

THE TREATMENT OF SEWAGE. — I.

THE following is the full text of Dr. C. Meymott Tidy's paper, an abstract of which was delivered before the Society of Arts, on April 14, last, and is too valuable not to receive the widest dissemination possible. As this paper is published in the *Journal of the Society of Arts*, a publication which is maintained more for the recording of useful information than for profit, we do not have those qualms of conscience that even American editors experience when committing pillage on the labors of others.

LIQUID EXCRETA.

Every adult male person voids on an average 60 ozs. (= three pints) of urine daily. The 60 ozs. contains an average of 2.53 oz. of dry solid matter, consisting of —

Urea	512.4	grains.
Extractives (pigment, mucus, uric acid)	169.5	"
Salts (chiefly chlorides of sodium and potassium)	425.0	"
	1106.9	"
	= 2.53	ozs.

The urine, therefore, of a population of 10,000 adults may be taken as 600,000 fluid ozs., or 3,750 gallons per day.

Urine rapidly decomposes, the urea becoming the volatile body carbonate of ammonia, and the urine thereby losing a valuable manurial constituent. After a time, but at a later stage, certain foul smelling gaseous products of decomposition are evolved. To collect and preserve urine, therefore, presents practical difficulties. The ammonia from stale urine was formerly distilled and converted into a sulphate, at Courbeville, near Paris.

[1] Medical Clinic.— Ospitale Gesu e Maria, monthly supplement of the Gazette degli Ospitali, Naples, June, 1885.

[2] In this manner it is possible to explain the case cited by Dr. Holmes from Rev. Cotton Mather's "Magnalia," of the Rev. John Sherman, who having contracted "an Intermitting but malignant *Fever*," at Sudbury, entered on his *Eternal Sabbath* August 8, 1685. It seems, however, that Mr. Sherman had formerly been settled in New Haven, and there is nothing to prevent the supposition that he may have afterwards visited that malarial region, and there contracted the disease of which he died.— *Dr. Holmes's Essay*, p. 22.

SOLID EXCRETA.

Every adult male person voids about 1,750 grains (or 4 ozs.) of fæces daily, of which 75 per cent is moisture. The dry fæcal matter passed daily is therefore about 1 oz. per adult head of the population. Of this *dry* fæcal matter, about 88 per cent is organic matter (of which 6 parts are nitrogen) and 12 per cent inorganic, of which 4 parts are phosphoric acid. Of this dry fæcal matter 11 per cert is soluble in water.

Taking a population of 10,000 adults, it follows that the moist fæcal matter passed daily is equal to 2,500 lbs. (= 1 ton, 2 cwt., 8 lbs.) or 1.116 ton, whilst the dry fæcal matter is equal to 625 lbs. (5 cwt., 2 qrs., 9 lbs.)

The facts, therefore, respecting the excreta of a population of 10,000 adults may be thus tabulated:

TABLE I.

FÆCAL MATTER PASSED PER 10,000 OF ADULT POPULATION PER DIEM.

	lbs.
Moist fæcal matter excreted	2,500
Dry " " " (calculating 75 per cent as moisture)	625
Soluble in water = 68.55 lbs. / Insoluble in water = 556.45 lbs. =	625

TABLE II.

URINE AND FÆCES PASSED PER DAY BY 10,000 ADULTS.

	Total solids.	Water.	Solids dry.	Solids soluble.	Solids insoluble.
	Moist lbs.	Gallons.	lbs.	lbs.	lbs.
Fæces	2500	187.5	625.0	68.55	556.45
Urine	——	3750.0	1581.21	1581.21	——
		3937.5	2208.21	1649.76	556.45

My own experiments would lead me to give one pint as an average quantity of urine passed by children daily up to the age of ten years, the quantity gradually increasing up to three pints in the adult. The solid constituents of the urine which, at the age of ten, are on an average 0.8 oz. daily, increase, according to my observation, up to 2.5 ozs. in the adults. The quantity passed by girls and women is rather less than that passed by boys and men.

This Table has been adapted from Letheby. The quantities given are somewhat below the normal. The facts were collected from a number of sources, the ratio of children to adults being that adopted by Roderer and Eichorn.

CONSTITUENTS.	Weight in ounces avoirdupois of chief constituents of urine and fæces passed by children and adults in 24 hours. Males. Boys.	Men.	Females. Girls.	Women.	Average at all ages.	Weight in lbs. of urine and fæces contributed by a mixed population of 10,000 persons (1,640 boys, 3,020 men, 1,662 girls, 3,674 women) in 24 hours. Males. Boys.	Men.	Females. Girls.	Women.	Total at all ages.
	oz.	oz.	oz.	oz.	oz.	lbs.	lbs.	lbs.	lbs.	lbs.
URINE.										
Fresh urine	19.875	48.490	16.881	42.157	31.851	2073.2	9152.5	1753.6	9680.3	22659.6
Dry constituents	0.969	2.197	0.780	1.588	1.376	99.6	414.7	77.9	364.6	956.8
(*a.*) *Organic matter*	0.677	1.720	0.574	1.216	1.172	69.5	324.6	59.6	279.2	732.9
Containing nitrogen	0.166	0.481	0.161	0.326	0.284	17.1	90.8	16.7	74.9	190.5
(*b.*) *Mineral Matter*	0.292	0.477	0.176	0.372	0.332	30.0	90.0	18.3	85.3	223.9
Containing phosphoric acid	0.035	0.069	0.024	0.049	0.044	3.6	13.0	2.5	10.6	29.7
" potash	0.040	0.078	0.027	0.055	0.050	4.1	14.7	2.8	12.7	34.3
FÆCES.										
Fresh fæces	3.421	5.240	1.061	1.414	2.784	351.5	989.9	110.2	324.7	1775.5
Dry constituents	0.879	1.112	0.282	0.376	0.602	90.3	209.9	29.3	86.3	415.8
(*a.*) *Organic Matter*	0.762	0.930	0.244	0.325	0.567	78.3	177.2	25.3	74.6	355.4
Containing nitrogen	0.049	0.062	0.016	0.022	0.037	5.0	11.7	1.6	5.0	23.2
(*b.*) *Mineral matter*	0.117	0.173	0.038	0.051	0.095	12.0	32.6	3.9	11.7	60.2
Containing phosphoric acid	0.039	0.062	0.013	0.018	0.033	4.0	11.7	1.3	4.1	21.1
" potash	0.014	0.029	0.004	0.006	0.012	1.4	4.3	0.4	1.4	7.5

The fæces passed by girls and women are considerably less than that passed by boys and men. The calculations in the Table state the amount as less than one-third. My own observations, however, scarcely support these numbers. It would, I think, be more accurate to regard the fæcal matters passed by female children and adults as about one-half that passed by male children and adults.

VALUE OF NIGHT SOIL (HUMAN EXCRETA).

Urine, in its natural condition, has a theoretical value of between

15*s.* and 16*s.* per ton. The dry solid matters of the urine have a theoretical value of about £18 16*s.* per ton.

The quantity of ammonia per year voided by the average individual in the urine has been stated as from 10 lbs. to 11.32 lbs., having a value on the lower quantity of 6*s.* 8*d.*, and on the higher of 7*s.* 3*d.*

Fæcal matter, in its moist and natural condition, has a theoretical value of £1 7*s.* 6*d.* per ton. The dry solid matters of fæces have a theoretical value of £5 17*s.* 7*d.* per ton.

The quantity of ammonia voided per year in the fæces, by an average individual, is estimated at 1.64 lbs., having a value of about 1*s.* 3*d.*

The estimates given above are based on the agricultural values of the nitrogen calculated as ammonia, together with the phosphoric acid and potassium salts, these being materials of sparing occurrence in land, but entering largely into the composition of every variety of agricultural produce. Lime, magnesia and iron, equally essential to plant development, occur largely in most soils. The details are stated in the Table on p. 1129 : —

Respecting the value of the nitrogen, however, of sewage, Voelcker regards it as at least of 10 per cent less value than the nitrogen of ammoniacal salts ready formed.

Authorities differ between 6*s.* 6*d.* and £1 in estimating the annual value of the excreta of one adult. Thudichum gives it at £1 ; Hofmann and Witt at 11*s.* 9¼*d.*; Voelcker at 9*s.*; Lawes and Way at 8*s.* 5¾*d.*; Anderson, of Glasgow, at 8*s.*

In the Table we have estimated the mixed excreta of the population as worth 15*s.* 8*d.* per ton in their natural condition, and the solid matter of such mixed excreta as worth £14 15*s.* 4*d.* per ton.

In this Table, moreover, no corrections are made in stating the value of the solid constituents, either for the loss of ammonia that would occur during evaporation, or for the soluble phosphoric acid of the fresh excreta becoming insoluble by its combination with lime after drying. No doubt the loss from these causes is considerable, and tend to show that, when used as a manurial agent, sewage should be applied to the land in its fresh state.

COMPOSITION AND ESTIMATED VALUE OF THE SOLIDS OF URINE AND FÆCES, AND OF THE MIXED EXCRETA OF A POPULATION.

Constituents per ton.	Ammonia (= 7d per lb).	Phosphoric acid.		Potash[1] (= 3d. per lb).	Estimated value per ton.
		Soluble (= 4d. per lb).	Insoluble[1] (= 2d. per lb).		
A. NATURAL STATE.	lbs.	lbs.	lbs.	lbs.	£ s. d.
a. Urine	23.94	2.94	—	3.39	0 15 10
b. Fæces	35.45	—	26.62	9.46	1 7 6
c. Mixed excreta of population	23.13	2.70	1.93	3.83	0 15 8
B. SOLID MATTERS OF.					
a. Urine	567.14	69.53	—	80.32	18 14 1
b. Fæces	151.77	—	113.67	40.40	5 18 7
c. Mixed excreta of population	441.31	48.47	34.43	68.21	14 16 4
d. Sewage of mixed population	172.10	24.89	10.19	48.20	6 8 2
Rotten farm-yard dung	16.0	3.92	5.77	10.00	0 14 1
Fresh farm-yard dung	15.0	3.0	3.92	12.50	0 13 6
Peruvian guano	381.8	67.0	201.00	13.50	14 1 4
1,000 tons of average London sewage	219.37	27.61	24.20	50.65	0 0 1¾

These estimations of value are theoretical only. Cesspool matter in Paris fetches from 1 franc to 1 franc 25 cents per cube meter (about 1 ton), whilst in Holland and Belgium the average is one shilling per head per annum for the excreta. It would scarcely be an exaggeration to place the real value of the excreta at about one-sixth their calculated value.

Certain comparisons in respect of fertilizing power (and, therefore, of agricultural value), are worth noting —

1 lb. of human excrement ..... = 13 lbs. of horse dung.
" " " ..... = 6 lbs. of cow dung (Macaire and Marcet).
Excreta, of one adult (solid and liquid ..... = Droppings from one sheep (Mechi).
Yearly excreta (solid and liquid) of one adult ..... = 75 lbs. of Peruvian Guano (Voelcker). (This will yield 3.2 bushels of grain.)
Yearly excreta (solid and liquid) of one adult ..... = Yield of sufficient nitrogen (16.41 lbs.) to furnish the nitrogen of 800 lbs. of wheat, rye, or oats; or 900 lbs. of barley, value £5. (Boussingault.)

MIDDENS.

Sewage absorbents.— The cesspool and the midden were the first attempts at collecting excreta, not so much, however, for the purpose of profit as with the idea of preventing nuisance. The cesspool had many and great disadvantages, not the least of which were the noxious inhalations evolved, the necessity of occasional emptying, and pollution of the drinking water of the wells in the neighborhood. The ash-pit midden had, and has, its advantages and its difficulties. Of the difficulties, the education of the people to use them properly was chief, a difficulty, however, that applies almost as much to water-closets as to middens. A second difficulty in the use of the middens consisted in securing proper scavengering arrangements by the local authority, a difficulty, it may be again noted, not one iota less great in securing the efficient treatment of sewage. Provided the midden be regularly attended to and properly constructed, *e. g.*, erected away from the house — the pit small — roofed in so as effectually to stop out rain or other water — floored with sloping flags to render the removal of the contents easy — impervious to surface water and not drained, dryness of contents being effected by the use of ashes well distributed over the soil — there are more objectionable ways of dealing with refuse than by the midden system. Under conditions of individual and general supervision, the compost, if sufficiently often removed, need not be a nuisance. But if the midden be neglected by the public authority and by the householder, no doubt it may become a prolific source of disease, as Manchester and Liverpool can testify.

[1] 2*d.* per pound would perhaps be nearly the value of potash, and 1*d.* the value of phosphate of lime.

The advantages of the pail system are not to be overlooked. Thus the pails are always placed outside the house; whilst a certain regular process of inspection is rendered necessary, ensuring the detection of a nuisance before it becomes a source of danger. In time of epidemics, again, disinfectants may be extensively used in the pails as they are being distributed.

Another great advantage of the midden system is to be found in the diversion of excremental matters from rivers and water-courses. Much sewage at Manchester is thus kept out of the River Medlock. Strange to say, however, the Rivers Pollution Commissioners (Dr. Frankland) state that the sewage from water-closet towns is no worse than that from midden towns. The following is an abstract of the results recorded by Dr. Frankland : —

AVERAGE RESULTS.

	Matters in Solution.			Matters in Suspension.	
	Total Solids.	Chlorine.	Total Nitrogen.	Total.	Organic.
Midden town sewage (37 samples from 15 towns)	57.68	8.08	4.52	27.38	14.91
Water-closet town sewage (50 samples from 17 towns)	50.54	7.46	5.41	31.29	14.36

On this one question suggests itself — how is it that the suspended matter in the sewage of midden towns is almost identical with that from water-closet towns, seeing that Dr. Frankland states that an average of 25,561 tons of solid matter per annum is annually kept out of the sewers at the several midden towns mentioned? (See Report on Pail System at Nottingham by Dr. Seaton, Society of Arts Conference, 1875, p. 155.)

The pail system may consist either in the use of a little disinfectant or of some absorbent material.

Adopting Mr. Gilbert R. Redgrave's classification of the pan, pail, and midden systems of disposing of sewage (Society of Arts Conference, 1877, p. 33), we shall discuss the subject under the following three heads : — I. Pails without absorbents. II. Pails with absorbents. III. Pails used for the joint collection of ashes and excreta.

I. — PAILS WITHOUT ABSORBENTS.

Of these the Rochdale system (see Society of Arts Conference, 1877, pp. 9 and 33, Mr. Alderman Taylor and others) may be regarded as principal. In support of the non-use of any absorbent, it is urged that to keep out "the profligate associate" is a main object; concentration, not increase of bulk, being the point to be aimed at. The excreta and dry house refuse should be collected at intervals in separate tubs of special construction, the excreta tub being fitted with an air-tight lid, so that transport may be effected without causing a nuisance. The cost per pail per annum is about 5*s.* 8*d.* The ashes are carefully screened and sorted.

From the experience of many towns (Rochdale, Salford, etc.), it would appear that two men and one horse (say at a working cost of £3 per week) can remove 600 tubs or pails per week, each pail containing an average of 84 lbs. of excremental matter. This equals 22½ tons per week at a working cost of 2*s.* 9*d.* per ton. At Rochdale, 10,112 pails were in use in 1882, the weight of excreta collected being 8,518 tons, and of refuse ashes 18,396 tons, from 15,289 houses, and 237 mills and workshops, with an estimated population of 65,500. In 1881, 552 tons of manure was manufactured. It is calculated that a tub is used by 9.2 persons living in 2.2 houses, the yield being 2.07 cwts. of excreta per head per annum. At Halifax it was calculated that each tub is used by 10.9 persons living in 2.6 houses, the yield being 3.26 cwt. of excreta per head per annum. At Birmingham the returns give from 9.6 to 11.5 lbs. per week per head.

II. — PAILS WITH ABSORBENTS.

In many places, the use of boxes, pails or tubs, charged with various absorbent materials (ashes, etc.), has been adopted. Numerous substances (see paper in Society of Arts Conference, 1877, p. 49) have been suggested as absorbents. Of these Liebig recommended coarsely-powdered bog turf and Stanford charred seaweed. Stanford claims that seaweed is three times, weight for weight, as effective as dry earth (1 cwt. being sufficient for one month for a closet daily used by six persons. He claims, moreover, that it is easily reburnt, and that the ammonia and fixed salts have been recovered, the charcoal remains as effective as before. Various forms of refuse, too, have been suggested as absorbents, of which may be noted, refuse wool or shoddy, dry horse-dung, spent dye-stuffs, etc. At certain towns, spent dye-wood (such as fustic), in the manner suggested by Goux, viz., ramming into a tub by a central core, so as to give a uniform lining to the tub, has been employed. Thus splashing is prevented. This method necessitates the frequent removal of the excreta (otherwise the absorbent lining would break down and a semi-liquid mass result), and it is also necessary that the receptacle should

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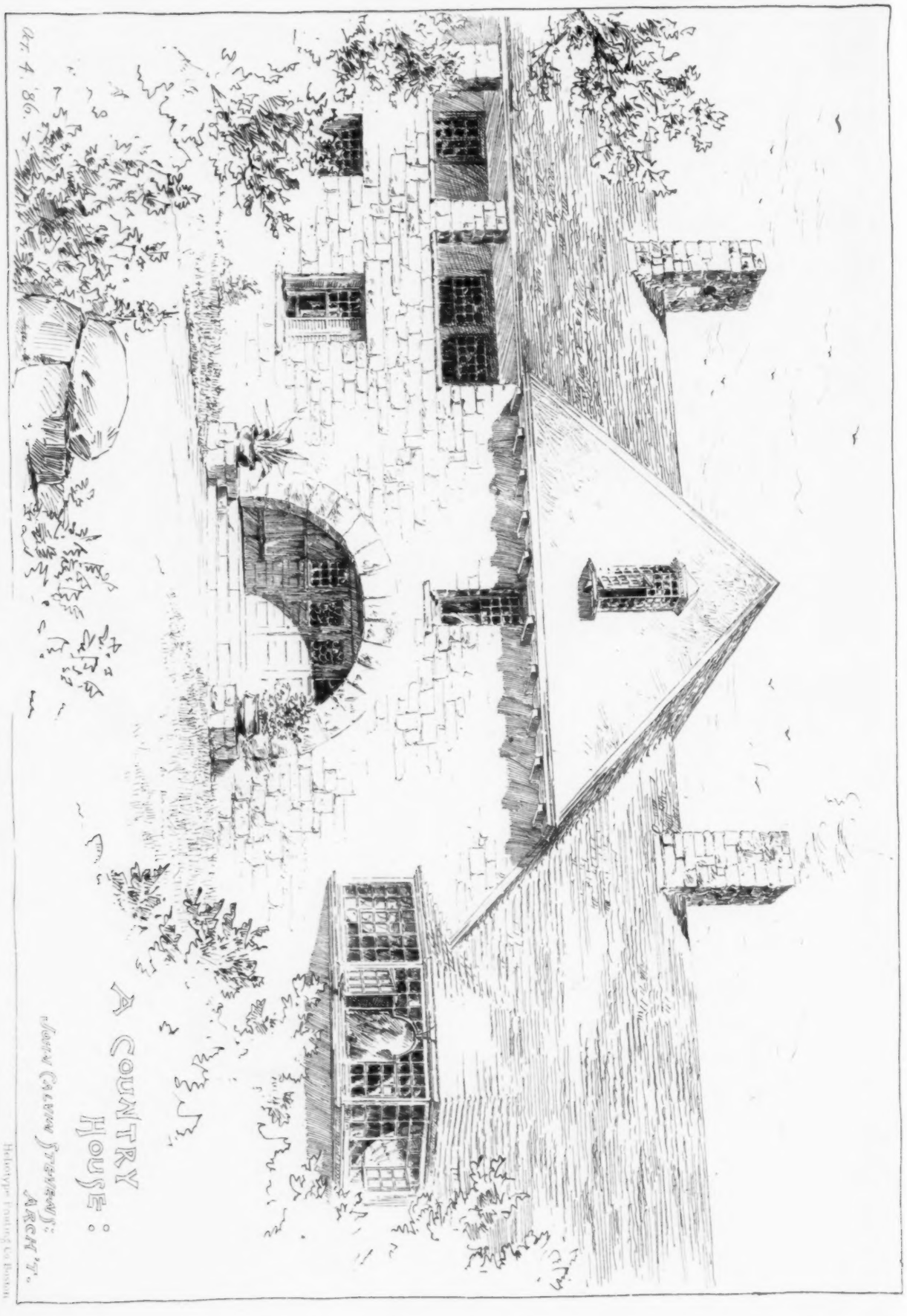

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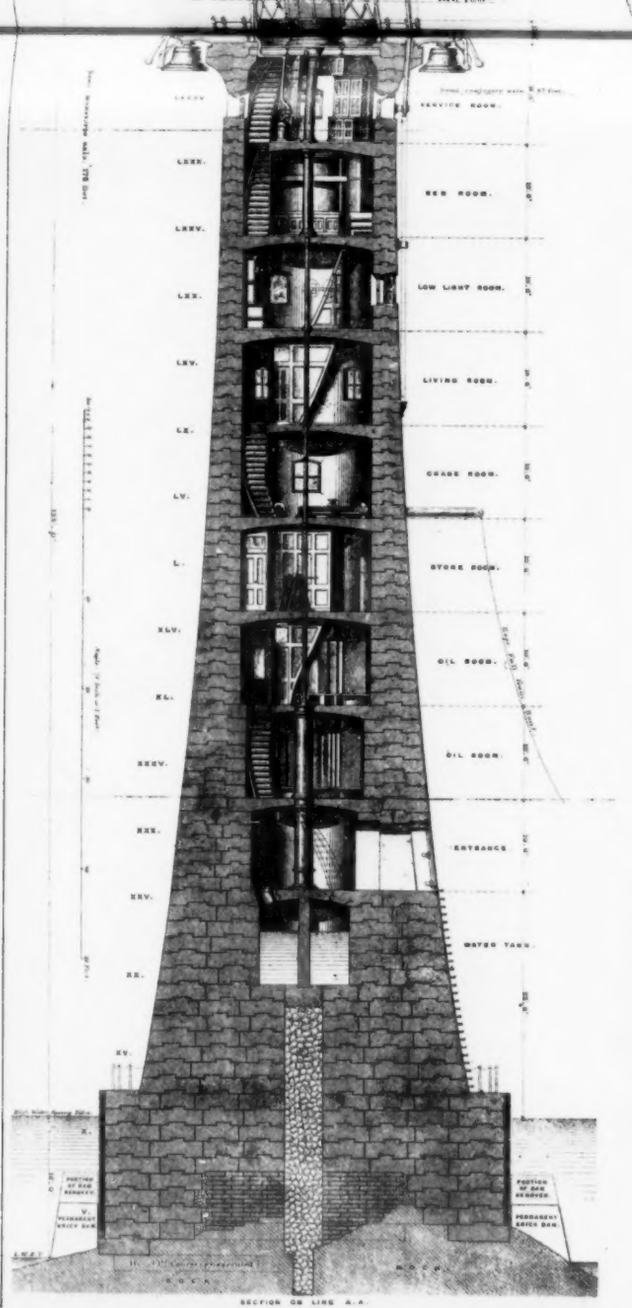

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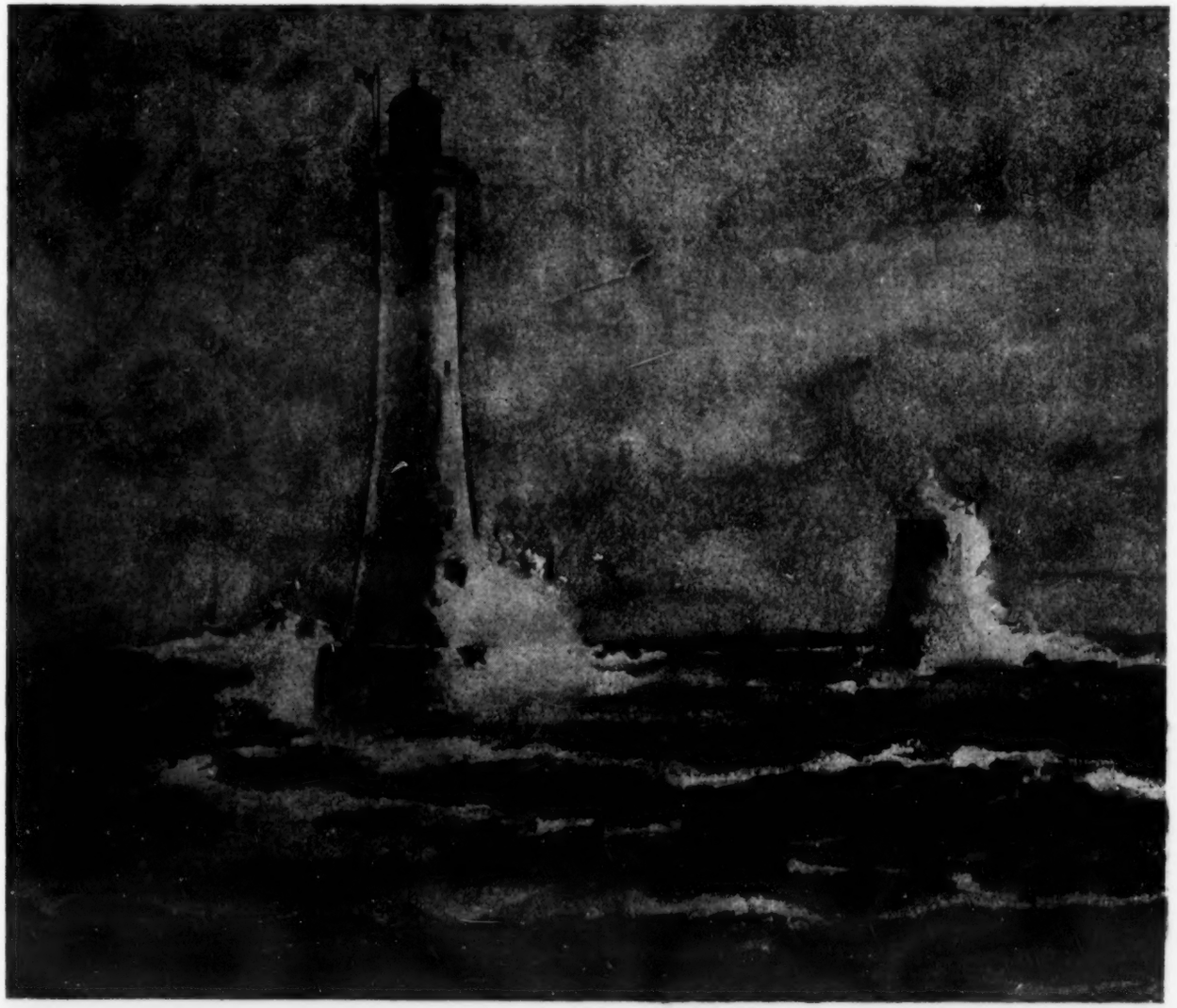

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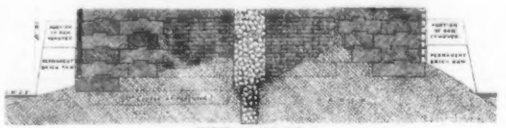
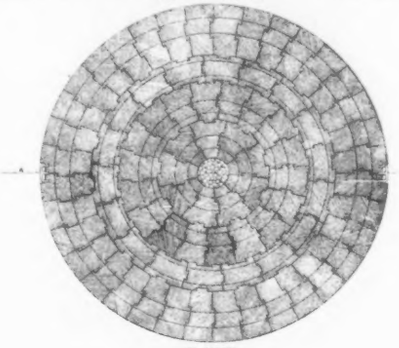
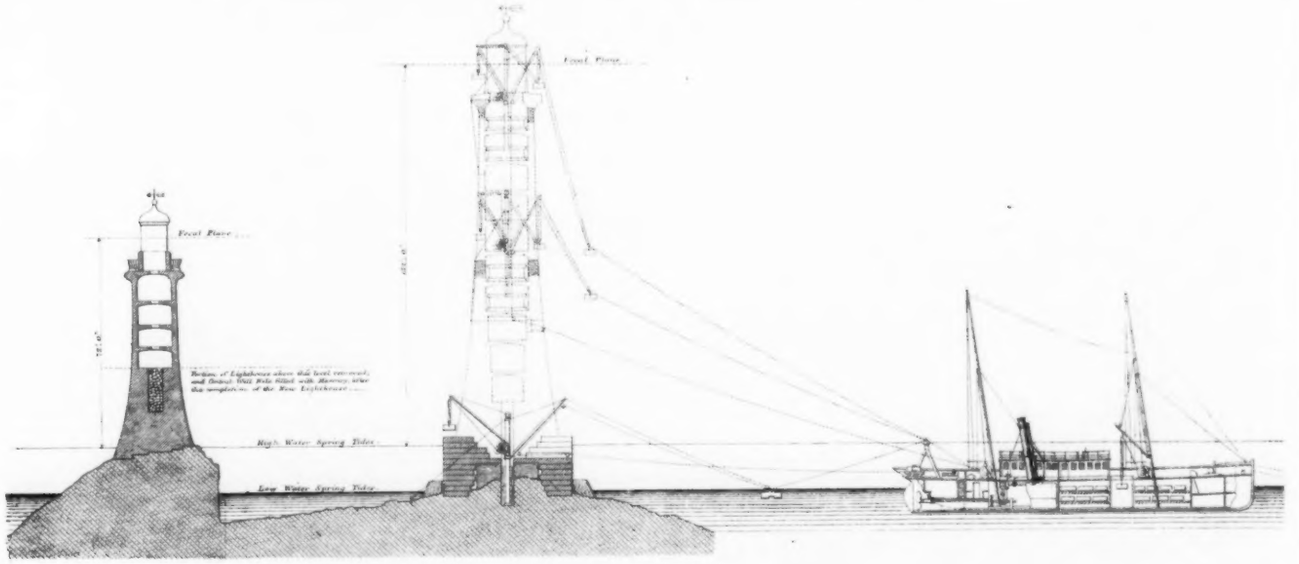
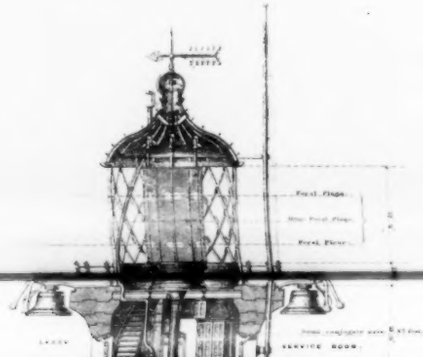


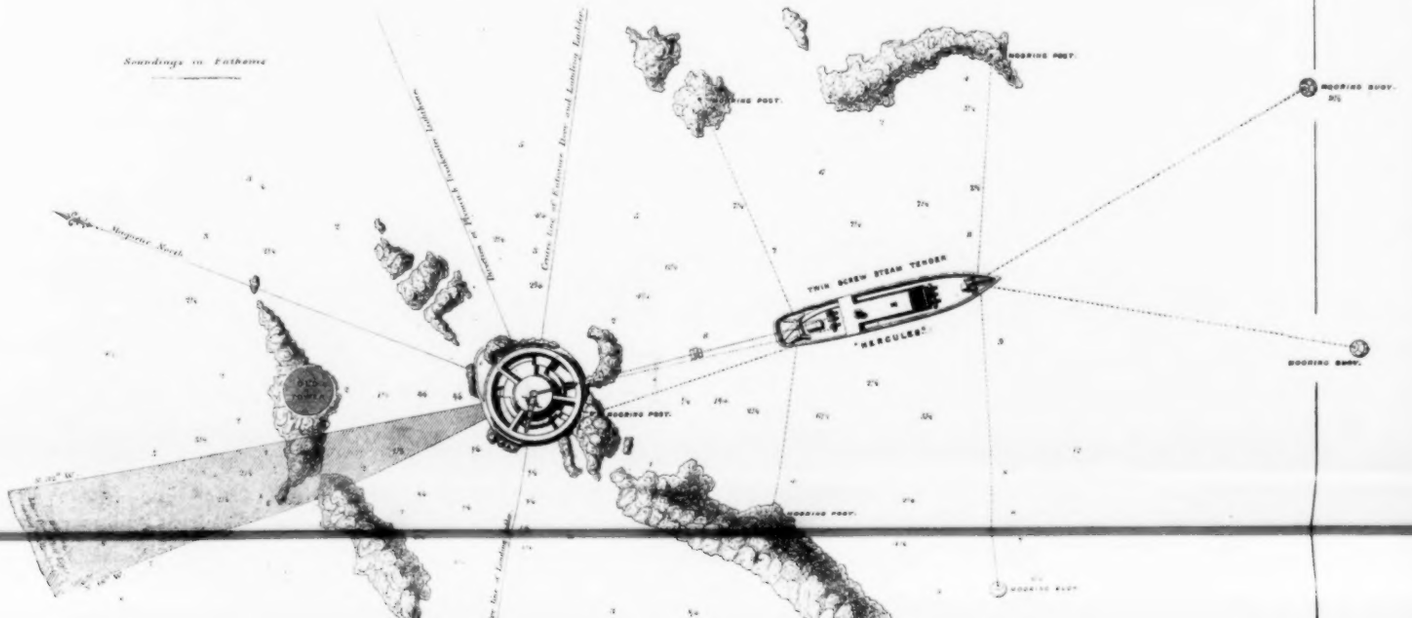




PLAN AND SECTION AT LOW WATER SPRING TIDES, SHEWING LANDING AND GETTING ARRANGEMENTS.

THE NEW EDDYSTONE LIGHTHOUSE.





be tightly secured before removal to prevent escape of offensive effluvia during transit.

[For a full description of the Goux system, as carried out at Halifax, see remarks by Mr. Councillor Pollard, Society of Arts Conference, 1877, p. 2.] The tubs are packed with screened ashes, soot (cost, 50*s.* per ton) or peat charcoal (£3 per ton), shoddy or mill refuse (cost 2*s.* 6*d.* to 7*s.* per ton), street sweepings, to which sometimes disinfectants are added. The closets are cleared every eight days, except when there is fever in a house, when it is removed every two days. The packing of each tub will absorb from six to eight quarts of liquid. It is said to work satisfactorily. The cost is about 18*s.* 6*d.* per annum per closet, whilst the material fetches from 3*s.* to 7*s.* 6*d.* per ton. Dr. Syson (Peterborough) and Mr. Haviland (Northampton) speak in favor of the system, the latter contending that where it has been adopted, the death-rate showed improvement. Any good absorbent that can be obtained at a cheap rate on the spot may be used, *e. g.*, tan. The material after emptying has little smell.

III. — PAILS USED FOR THE JOINT COLLECTION OF ASHES AND EXCRETA.

Of this method the system adopted at Nottingham is a case in point. Here the tub takes the place of the midden pit. It is to be noted that the ashes are of less quantity in summer time, when the chance of nuisance is greatest.

With respect to the mechanical appliances suggested for sifting the ashes, so as to apply only the smaller breeze to the excreta, practice proves them somewhat unsuccessful.

The compost is removed every two or three months and conveyed to the manure wharf, where it is emptied into barges and sold at a price that covers two-thirds of the cost of scavenging.

At Birmingham, where galvanized pails are used to the extent of some 40,000 (representing a population of 250,000), the contents are collected weekly. These are emptied into a vat at the place of deposit, and some sulphuric acid added to fix the ammonia. The contents are passed into a drying-machine, consisting of a steam-jacketed cylinder, within which are revolving arms, the necessary heat being obtained by burning the cinders and garbage collected in the town. The clinkers are utilized for various purposes.

The process adopted at Manchester, devised by Mr. Leigh and carried out by Mr. Whiley, was described in detail by Mr. Alliott, of Nottingham, at the Society of Arts Conference, 1877 (p. 7, also 37). The objects are (1) the disinfection of the pail contents by the use of charcoal, produced by charring street sweepings; and (2) the reduction in bulk of the matters so collected. For the purpose of reducing bulk, the liquid in the pails is drained off, and concentrated by a low heat to the consistency of treacle (about one-tenth the original bulk). The heat necessary for effecting evaporation is obtained by passing the products of the combustion of house refuse over the surface of the liquid. (Fryer's concreter.) A certain amount of sulphurous acid is thus generated, which serves to prevent the material from becoming alkaline, whilst the temperature, it is said, is sufficiently kept under to prevent loss of ammonia. The liquid thus obtained contains nine to ten per cent of ammonia. (Angus Smith.) A second variety of manure is made from the fæcal part of the pail stuff, which is also evaporated down to a certain extent. A third variety is prepared from the carbonized refuse, saturated with some of the concentrated urine, mixed with fæcal matter; and a fourth variety of manure from the fish and slaughter-house refuse, mixed with ashes, urine and fæces.

I do not propose discussing the pneumatic system of collecting excreta. In certain places on the Continent (Paris, Milan, etc.), the sewage is collected in water-tight cesspools. These are emptied by atmospheric pressure, the contents being forced into movable exhausted iron tanks, through flexible tubes lowered into the cesspool for the purpose. By this means the escape of noxious effluvia is supposed to be prevented.

The cost of removing the excreta at Paris is about £5 per house per annum. The material is converted at Villette into *poudrette*, great nuisance resulting (Society of Arts Conference, 1877, p. 14). The arrangements of Liernur (which have been adopted in Amsterdam, and to a certain extent in Prague), are, in many respects, similar. Liernur suggests cesspool tanks being placed in the middle of a street, each tank communicating with from fifteen or twenty houses.

The systems of Berlier, partly in use in Paris since 1881, and of Shone, a method of pumping sewage by small pneumatic pumping-engines, the power being generated at a central station, need only be mentioned.

As general rules we consider: —

1. That the removal of the pails should be under the control of the local authority.

2. That on an average they should be renewed once a week, a clean, well-washed pail being substituted for the full one.

3. That air-tight covers should be fitted to the pails before removal, and that they should be conveyed in air-tight vans to the depot.

The utilization of the excreta collected in pails is a matter of great difficulty.[1] At best a low class of manure results, unless some form of concentration be adopted.

Voelcker states that having examined every form of night-soil manure, he never found one having a theoretical value greater than £1 per ton, unless the manure had been specially fortified with guano, or superphosphate, or sulphate of ammonia, etc. The better varieties he valued at from 15*s.* to 17*s*, 6*d.* per ton, whilst those less carefully prepared were not worth more than from 7*s.* 6*d.* to 12*s.* 6*d.*

[1] For an account of Milburn's drying machinery, see Society of Arts Conference, 1877, p. 52.

THE EARTH-CLOSET.

The disinfecting power of earth has been known from remote antiquity. In China, the formation of a manure by mixing earth with the excreta is of ancient date.

In this country, Rosser, in 1837, proposed the admixture of urine and fæcal matter with earth, lime, etc. The suggestion took no practical shape until 1858, when the Rev. Henry Moule, the vicar of Fordington, investigated the disinfecting and deodorizing power of earth on privy soil. As the result, he invented his earth-closet. At his own vicarage, where the cesspool proved to be dangerously near the well, he abolished the cesspool, and placed buckets beneath the pans. Their contents were, in the first instance, mixed with dry sifted earth, earth afterwards being placed in the bucket itself, and the compost left to consolidate in a shed. After five or six weeks he found that the material had entirely lost its offensive odor, and was sufficiently dry to be used again. Thus eventually he not only disinfected his sewage, but produced a manure containing one-third its weight of dry excrement. The next point was the mere mechanical construction of a closet, worked by a handle, with contrivances to secure the application of a proper proportion of dry earth. The earth may, however, be thrown into the closet in one application daily, a method adopted in the latrines at Lancaster, which are under the control of the local authority.

As regards the earth best adapted for the purpose, a well-dried clayey earth, that is, a heavy soil loaded with clay, holds the first place; peaty earth comes next, although for efficiency a long way behind a clayey earth. The peaty earth used at the Wimbledon Camp in 1867 was not satisfactory, as it produced a wet and sour compost. Sand and clay are found to have very little deodorizing power, and are therefore ill-suited for the earth-closet. The clay soil must be well dried artificially (for in a damp condition its absorbent power is inferior), and after drying, powdered and sifted.

About 4½ lbs. of dry earth per head per day (*i.e.*, 1½ lbs. for each visit, three visits being allowed for each person), is required to obtain a consolidated and unoffensive compost. This quantity was ultimately used at the Dorset County Gaol, the 3 lbs. per head of earth used in the first instance being found insufficient. A village of 1,000 persons would need, therefore, about 2 tons of dry earth per day. The dry earth system was used at the Dorset County School, at the villages of Halton and Aston Clinton near Windover, in Lancaster, and at the Wimbledon Camp. In this latter case Dr. Buchanan closely investigated the working of the process.

After the removal of the earth it may be dried and returned to the closet until its manurial value justifies its sale.

As regards composition and value of the product, much will depend on the demand, and on the method adopted in working (*i.e.*, how many times the material had been used). At Lancaster the compost fetched 7*s.* 6*d.* to 10*s.* per cubic yard. At Dorset County Gaol it reached £1 per ton, and at the Dorset County School £2 to £3 per ton. Perhaps 10*s.* per head of the population annually might be taken as an approximate value.

The dry-earth system has certain definite advantages over the water-closet. The first cost is less. It reduces the quantity of water required by each household. The closet is less liable to go wrong, to suffer injury from frost, or to be damaged by improper substances being thrown into it. No doubt an intelligent person can manage it, but if it be used in villages it should be managed by the local authority, easy access to the closets by the scavengers being, in such case, indispensable. Of course, a dry-earth system does not supersede the necessity for some independent means of removing slops, rain, and subsoil water.

A still further advantage claimed for the earth-closet is the manurial value of the compost, and the ease with which it may be stored until required.

No doubt the earth-closet has its objections. Of these, a certain filthiness (real or imaginary), and the difficulties of supplying the necessary quantity of dry earth and of removing the compost, are those chiefly urged. No doubt the collection of material that may be more or less foul as the closet has or has not been attended to by the scavengers, and the after distribution of the compost, compare, at first thought, unfavorably with the cleanliness of water, and the ease with which it serves to convey the filth from the closet to the field. But this assumes (1st) no misadventure of the water-carried sewage between closet and field; (2d) a farm and a crop ready at all times and seasons — wet or dry, summer and winter — to receive and to appropriate it; and (3d) no escape of noxious effluvia and miasms, no spread of disease, and no pollution of water courses. How far such assumptions are realized I shall consider presently.

Earth-closets have been largely used, and their use is rapidly extending in India, where the drying of the earth is a comparatively easy process. The authorities in India, in 1867, reported to the Secretary of State that Moule's system, which was then generally employed in the barracks, gaols, hospitals, and public institutions of the three presidencies, had been found to be a great public benefit. I can, myself, bear testimony to the excellent results of the dry earth

system where the closets are properly attended to — proper earth used — and the materials properly dried.

THE ILLUSTRATIONS

Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.]

Note: — After our text pages had gone to press last week we found that Plate XXX of the series of the Rotch Travelling Scholars, issued only with the Imperial edition, promised to be so unsatisfactory that we decided to withhold its publication until a better impression could be secured.

EARTHQUAKE EFFECTS AT CHARLESTON, S. C.

[Gelatine print issued only with the Imperial and Gelatine editions.]

By the kindness of Messrs. Walker, Evans & Cogswell, of Charleston, S. C., we are allowed to reproduce these views from the interesting collection of similar views published by them.

THE NEW EDDYSTONE LIGHT-HOUSE.

For description see our issue for October 9 last.

THE ARCH OF CONSTANTINE, AFTER AN ETCHING BY PIRANESI.

It will be interesting to compare this plate with the photo-caustic print of the same arch published in our issue for July 10 last.

HOUSE FOR HARVEY PEAL, ESQ., CORNER OF FORTY-SEVENTH STREET AND CHESTNUT AVENUE, PHILADELPHIA, PA. MR. R. G. KENNEDY, ARCHITECT, PHILADELPHIA, PA.

A COUNTRY HOUSE. MR. JOHN CALVIN STEVENS, ARCHITECT, PORTLAND, ME.

EXTRACTS FROM PRIVATE LETTERS RELATING TO THE CHARLESTON EARTHQUAKE.

CHARLESTON, September 2, 1886.

My dearest L. — You will see by all the papers the terrible earthquake which has visited the whole South, and I have sent yesterday's Charleston papers to H. with imperfect accounts of its ravages in this city. Painful as they are, the paper tells but a portion of the calamity, and none was issued to-day, on account of the ruinous condition of the building, which makes them fear to use the heavy printing-press. Many lives have been lost, and people are in an anxious and unsettled state; but you will rather hear of ourselves, so I begin from the beginning of our own experiences. The afternoon was extremely sultry. Neither on Mr. Y's piazza nor on the Battery, where we went to find a car, was there a breath of air. We sat down on the Battery to admire the sunset; the clouds looked heavy and sulphurous. B. said they seemed to have a storm in them. The whole evening was sultry. B. and W. sat down to their lessons, and I, being tired, bade them good-night and went up stairs. I walked to the north end of the piazza and looked down the street; then, turning to go into my room I heard a heavy rolling sound, and immediately after felt the violent rocking of the earth, and caught hold of the little door to support myself. It moved backwards and forwards in my hands; then the room filled with white dust, and I looked to see if the plastering had fallen. Just at that moment J., who had been in bed, rushed into the room and seized hold of me, and I heard E. scream, "Oh, save my child;" then she and D., with K. in his arms, seemed to stop right at my door. They were all in their night-clothes and completely bewildered with fright, yet waiting for me to go first. I heard myself say, "take the child down," and J. ordered them to go down, and they rushed into the yard and we followed. W. said he thought it was a tornado, but he got B. out into the yard, then ran back and caught K. out of D.'s arms; but where was uncle J.? I went back to call him and found him making a leisurely toilet after a bath, and apparently the coolest of any of us. W. and B. went up into the second story and gathered shawls, shoes, etc., for those in need of them. We stood, and afterwards sat in the yard until there seemed a respite from the shocks — the servants with us — then we went into the piazza and sat during the night there or in the dining-room. K. slept a little on the sofa, though the least sound awoke her, and I think was more excited than frightened, though some heard her praying softly in the yard, "please, dear Lord, don't let the dreadful thing come again." Dreadful it really was; I cannot describe the sensation, and could only express it as, Oh, how awful! applied only to the dreadful rocking motion. After a while we went out in front to see the condition of things; several of our neighbors came to us, for the rush had been to the wide streets, and groups of negroes were gathered, some praying or singing very earnestly, but with a subdued excitement very unlike their usual noisy zeal. The whole of Aikin's Row rushed to the park and spent the night there in the open air; some improvised tents by throwing bed-spreads or pieces of carpet over a support, as shelter for the children; none ventured to go back into their houses; all the chimneys and many walls were shattered, especially the out-buildings; some of the houses were quite unsafe. As we were kept in constant excitement by the recurring shocks we spent a great part of the next day on the parks, and arranged to spend the night there; Mr. M. had got a long canvas and offered us a portion of its shelter; we sent out two lounges, etc. Ellen and Dick[1] were dreadfully alarmed, and would hardly enter the house for more than a few minutes at a time, though thus far our injuries are light compared with many, and we were mercifully preserved from fire, for, although our entry lamp fell over and shade and lamp were broken, while we were out of doors, it must have gone out in the fall. Many houses caught fire from this cause, and there were several large fires in the city to add to the misery of the night; fortunately, it was deathly still, which saved the fires from spreading. Our chimneys are all down and our plastering very much cracked, but they think the walls are secure, which is a great comfort. We spent two nights camping, but hope to stay at home to-night unless there is further alarm. Dr. Wilson, of St. Luke's church, and Mrs. Wilson, were like good spirits in our camp, so kind and sympathizing to every one. The doctor held a little service every night; on the first he made a short address on the dreadful peril which had brought us all together, said a few of the church prayers and the creed, and then Mr. Burgess made a solemn prayer. Through all of this my heart was with our darling K., so separated from us, and with her sick husband, and hearing the dreadful rumors from Summerville where her home and children are yesterday morning B. and T. determined to go to her. We took the East Bay cars and passed down through great destruction on each side to Tradd Street, when we got out and walked through the narrow streets filled with brick and mortar, houses apparently ready to fall on either side, so that we were glad to reach the wide space of Meeting Street, though that section is a mass of ruin, the Guard House down, and St. Michael's torn and riven in all directions. The Scotch church looks as if crumbling in every part, and the destruction is heart-sickening to look at. . . . H. came to us this morning with the dreadful accounts from Summerville, where the earthquake was at its height, and scarcely a house has escaped partial or entire destruction. Mrs. P.'s house is a wreck, and our dear H. is without a home.

Soldiers' Monument (bronze statue)
Forest Hills Cemetery, Mass.

J.'s is more severely wrecked than any — the great, strong chimneys coming down with a crash; you see how none can help the others except by sympathy. All the Summerville people are camping; the shocks still continue there, though lessened in force. They think Summerville is the centre of the earthquake. The M.'s house is down, and poor C., in her sickness, is sitting in the street. They all camp out, but it is so still to-day I hope they will make some better arrangement. J. G.'s house is so safe that J. is acting the Good Samaritan, and has mattresses spread for the many who come to her begging leave to rest there for a little while, some bringing their children. Some of our friends have sought shelter in boats. . . . The upheaval in Summerville was very great. Three springs of clear, sweet water burst up in J.'s yard, though their well filled to the top with horribly-smelling black mud. In our yard in Charleston little holes opened, throwing up water with yellow sand.

In the street was quite an opening from which water and sand were thrown out and flowed some distance. This occurred in many places. A man told me it was hot water, but it was not so when I put my hand in it by daylight.

But you will be weary of these details. From your loving

Mother.

Summerville, September 3, 1886.

My dear C. — I feel that I must write to you and let you know how we got off in our fearful visitation of the 31st of August, when we all expected in a few seconds to be launched into eternity. I am thankful to say we all escaped and succeeded in getting out almost in a

[1] Negro servants.

miraculous manner with the eleven little ones. It is useless for me to tell you that our home is a perfect ruin, and N.'s in so dangerous condition from the cracked chimneys that she, with her little ones, is in our yard. I had been sitting the evening with her, and had just entered our yard when the earthquake struck us. I got no further than the front door, and could only cling to it for support, L. rushing to me and throwing her arms around me, expecting to be killed any second (which seemed longer than minutes) by the falling timbers from the piazza.

When morning came we found every chimney down, all the brick pillars down or cracked throughout, and all that was keeping up the house was a few blocks which S. had put up last summer to support a weak sill, and "The everlasting arms," which are always around us. As soon as S. could get help he propped up the house with temporary blocks to try to save it from further ruin.

When God sends to man a visitation like this, he puts it into the hearts of his people to send relief, and I know your city will not be behind in sending help to Charleston. What I want you, dear friend, to do is, to let them know of our utter ruin, that we, too, may get some help, for without it I do not know what is to become of us, individually. I am so affected that I do not know how I have worded this letter. As I write I can hear from the earth the same sound as during the bombardment of Charleston. . . .

SUMMERVILLE, September 28, 1886.

Thank you, dear A., for your sweet letter, so full of sympathy. Our community is, as a general thing, calming down, but yesterday afternoon, at five o'clock, we had a sharp shock, which unnerved us all for a little while. When a shock passes off I feel so thankful that it is over without further damage. S. tells me that in the country, on the Ashley River, about fifteen miles from here, the ground is ploughed with furrows, and in one place his horse's feet sunk so deep in the bed of sand thrown up from the fissure that he would not venture nearer than about four feet, so could not see from there the depth of the opening, and that extended about half a mile in ridges up and down. The people are gathering up the sand, gravel and other things which have come up. Some pieces shown me resemble old pottery, but I did not see anything of that kind from the openings in Summerville. I wish you could see them; they are curiosities. The pieces I saw were got at Lincolnville, just below our railroad depot. . . . We are still sleeping in our out-houses. I think I wrote you that S. and M., with their six children, are in the storeroom; L., with her five, in the old kitchen. Mrs. S. has a tent pitched in our garden, where she sleeps at night with her five children. So you see we are quite a little settlement — sixteen children in all. We have a light in the yard and the children have a splendid time camping; we old folks sit under the large trees and talk over our experiences. But you must not think us woe-begone under our trials, for every one bears up with patience and cheerfulness, hoping it is over, and believing the noises and shakes we still have "the settling of the earth," or anything else the scientific men tell us. The old family mansion at Goose Creek (built in 1690) is destroyed, and S. went down on Saturday and had as much of the furniture as could be got out removed; it leaves them without a home.

You will be glad to learn that it is hoped the steeples of St. Michael and St. Philip may be saved. They thought the latter must be taken down immediately it was so unsafe, but some smart engineer from the Custom House showed the people how to cut out the injured part and put in supports, and they found strong arms and willing hearts to do it.

PARIS CHURCHES. — II.

THE SAINTE-CHAPELLE.

LOUIS IX, King of France, died on the 25th August, 1270, twenty-two years after the consecration of the Sainte-Chapelle, a building as perfect amongst churches as the King was perfect amongst men. His love of his mother was intense, and reflected well upon her for the careful way in which she had brought him up. A touching anecdote is recorded of Queen Blanche, which would make an excellent subject for an historical picture. It is related that one day at the court the Queen noticed a beautiful youth with long, fair hair, and asking who he was, she was answered, "Prince Herman, the son of the sainted Elizabeth of Hungary." On hearing this, Queen Blanche rose from her seat, gazed at the youth, and said to him, "Fair youth, thou hadst a blessed mother; where did she kiss thee?" The youth blushing, replied by placing his finger on his forehead between his eyes. Whereupon the Queen reverently pressed her lips to that spot, and looking up to Heaven, breathed an invocation, "*Sancta Elizabeth, Patrona nostra dulcissima, ora pro nobis.*"

It must be remembered that in the Middle Ages humility was a virtue which was highly cultivated. When we read of St. Louis carrying the holy relics from Sens to Paris, barefooted, we must look upon it as a practical demonstration of real feeling. In these days we are apt so much to pray in our closets, and to do our alms away from the sight of men, that it is sometimes doubtful whether we pray or give alms at all. In St. Louis's time this was not so, and even Voltaire sums up his character by saying, "*Il n'est guère donné à l'homme de pousser la vertu plus loin!*" Gibbon, too, allows that he united the virtues of a king, a hero, and a man. There is no evidence whatever, to prove that he was simply a fanatic, or in any degree a hypocrite. He was of a highly religious temperament, and an enthusiast; and he remodelled his conduct upon his ideal of what the life of a Christian prince should be, practising in all simplicity what he preached; a very rare virtue in these latter times.

Before the reconstruction of the eastern part of the Palais de Justice under Louis XVI, an elegant little edifice was attached to the chapel, which served as its sacristies. In the upper one were strong closets, containing the treasures which had accumulated since the days of St. Louis.

The first stone of the church was laid by St. Louis in 1245, and three years later, on the Sunday after Easter, Quasimodo, 25th April, 1248, it was consecrated by the Pope's legate Eudes de Châteauroux, Bishop of Tusculum, under titles of the Chapel of the Holy Cross and the Holy Crown. On the same day, Philippe Berruyer, Archbishop of Bourges, celebrated the same ceremony in the lower church, putting it under the patronage of the Blessed Virgin. It seems strange that Joinville should not speak of this event, and yet it must have been an imposing sight; but he does not once mention the Sainte-Chapelle in his life of St. Louis. Perhaps this may be accounted for by what he thus relates. "At Easter-tide, in the year of grace 1248, I summoned my vassals and retainers to Joinville, and on the Easter-eve . . . was born John, my son, Sire d'Ancarville. . . . We had feasting and dancing all that week, in the course of which my brother, the Sire de Vaucouleurs and other rich persons who were there gave banquets one after the other on Monday, Tuesday, Wednesday and Thursday;" and then he goes on to say, that he went to Metz on business before he started for the Holy Land; therefore we may suppose that private affairs kept him away from Paris, and that not being present himself, he did not consider it necessary to give an account of a ceremony that he did not witness.

Two charters dated Paris, 1245, and Aigues-Mortes, 1248, respectively, give the terms of the endowment by the King. The number of ecclesiastics who first formed the college was fixed at twenty-one; five principal priests or *maîtres chapelains*, each having an assistant chaplain, priest and a deacon, and three beadles who had as many clerks under them. The number was modified from time to time, during five centuries, and latterly it consisted of a treasurer, twelve canons and nineteen chaplains. The office of treasurer was generally filled by some important personage, and he had the privilege of wearing the mitre, and other insignia of the episcopate, and of giving the Benediction upon great festivals; but he was not allowed to bear the crozier.

Pierre de Montereau lived eighteen years after the completion of his *chef-d'œuvre*, and doubtless assisted at some of the splendid ceremonies held in it. He died March 17, 1266, and was buried in the chapel of the Virgin belonging to the religious of St. Germain-des-Près, where a splendid monument was erected to his memory. Some of the finest buildings belonging to the convent were his work; and up to the last century a stone was to be seen over his burial-place upon which he was represented with a rule and compass in his hands. His epitaph gives him the titles of *fleur pleine de bonnes mœurs* and of *docteur des architectes*. Another stone recorded the name of his wife Agnes, and on that he is termed, in old French, *mestre Pierre de Montereul*. The chapel has disappeared, and with it all trace of the tombs; but the one at Reims, erected in honor of Hugues Libergier, architect of the celebrated abbey church of St. Nicaise, who died in 1263, gives us some idea of what those of Pierre de Montereau and his wife must have been.

The most important event of the thirteenth century connected with the Sainte-Chapelle was the translation of St. Louis's bones from St. Denis, where they had been laid twenty-seven years before, on their arrival from Tunis. They had been placed behind the altar of the Trinity, near the tomb of Louis VIII, and of Philippe Auguste. The bull of canonization was promulgated by Pope Boniface VIII in 1297, and in the following year the body was exhumed and enclosed in a silver *chasse;* but it was not until 1306 that Philippe le Bel succeeded in placing the remains of his ancestor in the Sainte-Chapelle. The translation took place in the May of that year, accompanied by all the picturesque pomp of the fourteenth century. The fifteenth of May, 1843, an interesting discovery was made in the chapel. Some workmen, in lifting a stone of the pavement of the apse, found a box containing the remains of a heart, and a *procès verbal*, stating that it had previously been discovered on the 21st January, 1303. Although the spot where it was found indicated that it had belonged to some distinguished person, yet there was no clue to its owner — no inscription, or name, or date. The box was in the style of the thirteenth century, but it is seemed doubtful that had the heart been that of St. Louis, such an important relic would have been lost sight of, and no record of it have been given by the Benedictines at St. Denis in their inventory of treasures. The matter was referred to the Académie des Inscriptions et Belles Lettres, and fully discussed, but no decision could be arrived at, and consequently the box was replaced where it was found.

While the Kings resided in the Cité the most brilliant ceremonies succeeded one another in the Sainte-Chapelle; it was, in fact, the chapel belonging to the adjoining palace — now the Palais de Justice. The Queens Marie de Brabant, second wife of Philippe le Hardi, Marie de Luxembourg, second wife of Charles le Bel, Jeanne d'Evreus, third wife of the same prince, and Isabelle de Bavière, wife of Charles VI, were all crowned here. The marriage of the emperor Henri VII and Marguerite de Brabant, and the betrothal of Isabeau, eldest daughter of Charles VI, and Richard II of England were also solemnized here. Here, in 1332, Philippe de Valois held a great assembly of prelates and barons, to announce his project of another crusade against the Infidel — a project which was never carried out. On the feast of the Epiphany, 1378, Charles V, the Emperor Charles IV, and his son Wenceslas, King of the Romans, offered gold, frankincense and myrrh, after the manner of the three Holy Kings. Every time that the sovereigns convoked an assemblage of the clergy, the prelates first asked the blessing of the Holy Spirit, while prostrated before the relics. In 1483, when Louis XI was dying, he hoped to prolong his life by surrounding himself with the most sacred relics of his kingdom — so reluctant was this *dévot* to die! The holy Ampulla was brought by the religious of St. Remi from Reims; the canons of the Sainte-Chapelle took the Cross of Victory and Moses's Rod out of their treasury, and a grand procession of clergy and laity was formed on August 1, to carry them from Paris to Plessis-les-Tours. But alas! to no end; for on the 30th of the same month the poor creature finished his earthly career of hypocrisy.

Boileau gives an amusing account in his poem, "Le Lutrin," of an unseemly squabble between the canons. One Sunday, in 1667, one of them, who was a singer, found a huge desk placed in front of his stall. He protested against it, and the other canons took his part, ordering it to be removed. But the treasurer took the part of the beadle who had placed it there, and the discussion waxed fierce. Thereupon the decision of the president was demanded — one Guillaume de Lamoignon, and the end of it all was that the singer consented to abide behind the desk an entire morning during mass; and the treasurer, satisfied by the acknowledgment of his authority, had it removed before vespers.

An order of the Conseil d'État, dated March 11, 1787, sequestered all the goods of the chapel, suppressed the chaplaincies and canonries, and ordained that the services should be continued by the king's ordinary chaplains. Three years later it shared the fate of all the abbeys, chapters, and religious foundations, and soon after St. Louis's beautiful chapel was closed. The relics were sent to St. Denis, in honor, to be brought back later on in dishonor, and the other objects were dispersed to the national museums. *Propriété Nationale à Vendre* was written up on the building, a piece of information which has only disappeared in our time. Under the Directoire a club held its meetings there, and later it was converted into a warehouse for corn and flour. Towards 1800 a few ecclesiastics hired it and celebrated mass there, but in 1803 it was further profaned; the upper chapel was turned into a depository for the archives, and the lower one became the dépôt of the Cour des Comptes. In vain Louis XVIII and Charles X tried to restore it to its proper use; and it was only in 1837, in the reign of Louis Philippe, that its restoration was decided upon. MM. Duban, Lassus, Viollet-le-Duc, and Bœswilwald were commissioned to undertake the work at a cost of 2,000,000 francs, a sum nearly equal to the original value of the treasures (2,800,000 francs), while it exceeded by nearly two millions the original cost of the building — 800,000 francs. The 3d November, 1849, the work was efficiently advanced for the ceremony of the institution of the magistracy; and each succeeding 3d of November a mass has been said, accompanied by the original chants in use in the chapel in former times, and in presence of the judges and members of the Palais de Justice. This is the only occasion on which any religious ceremony is held there.

Some strange customs prevailed in former times, connected with the chapel. On the feast of the Holy Innocents, the acolytes were in the habit of vesting themselves as canons, and receiving homage as such — a custom of travestying holy offices which prevailed in many churches in the Middle Ages.

On the Good Fridays of each year the chapel scarcely sufficed to contain the crowds of sick persons who flocked to it from all parts of the city. All maladies were supposed to be curable through the virtues of the holy relics, but specially that known formerly as *le mal caduc*. At midnight the cross was exposed, and at the same moment the chapel was filled by the most fearful shrieks. The afflicted threw themselves about, foamed at the mouth, and fell into convulsions, invoking the aid especially of St. John the Baptist and St. Spire. The people were convinced every year that some wondrous miracle had been wrought; but the abuses were so great that in 1781 Louis XVI interdicted the nocturnal exposition of the cross. At the present time the legendary relics of the True Cross and the Holy Crown are exposed at Notre Dame during Holy Week, and carried in procession on the evening of Good Friday. It is not known when the archives were first installed in the treasury of the Sainte-Chapelle; but in 1615, when an inventory was drawn up by Pierre Dupuy and Théodore Godefroy, there were three hundred and fifty drawers, two hundred and sixty registers, fifty-two bags, forty-two shelves and fifteen coffers. This inventory consists of eight volumes of manuscripts in folio. In 1783 the sacristy was sacrificed to the love of symmetry in the new *cour d'honneur*, and the archives were removed to the Chancellerie du Palais. At the present time some of them are in the Bibliothèque, but the greater part are at the Archives Nationale in the rue Rambuteau.

The state of dilapidation into which the chapel had fallen when the restoration was commenced was terrible. The tracery of the windows was destroyed, the glass was broken and filled up with plaster, the *flèche* and gargoyles had disappeared, and the interior was filled with shelves and woodwork for the storage of the archives.

It was the same class of destruction that had taken place in the chapter house of Westminster Abbey, and which makes us wonder if our ancestors were deficient in all love of the beautiful.

The dimensions of the building are as follows:

Length of exterior	36	metres.
Length of interior	33	"
Width of exterior	17	"
Width of interior	10.70	"
Height of exterior from the ground of the lower chapel to the point of the gable of the façade.	42.50	"
Height of the *flèche* to the summit.	33.25	"
Height of the vault of the lower chapel under the key-stone	6.50	"
Height of the vault of the upper chapel	20.50	"

M. Viollet-le-Duc in his "*Dictionnaire raisonné de l'architecture*," thus describes the building: "*De la base au faite, l'édifice est entièrement construit en pierre dure de choix, connue sous le nom de liais cliquart (Portland stone); chaque assise est cramponnée par des agrafes de fer coulées en plomb; les tailles et la pose sont exécutées avec une précision rare; la sculpture en est composée et ciselée avec un soin particulier, sur aucun point on ne peut constater ces négligences qui ne sont que trop souvent le résultat de la précipitation.*" At page 401 of the above work is an explanation of the system of courses employed by Pierre de Montereau; a manner of strengthening which was in use before the masonry — thirteenth century — but which was improved upon by the architect of the Sainte-Chapelle. It is very similar to the system now in use.

The only communication between the lower and upper chapels at the present time is by means of the small turret staircase; but formerly the upper church was approached by a wide exterior flight of forty-four steps. It was reconstructed many times, and the last, in Egyptian style (!) was dated 1811. The demolition of this is no cause of complaint, but it seems a pity it should not have been replaced by one in better taste, as the only approach to the upper chapel (except the turret stairs) is through the corridors of the Palais de Justice.

The first thing that strikes the visitor is the enormous size of the windows, which occupy the entire space between the buttresses, and rise to the base of the roof. All the weight of the vaulting rests, therefore, upon the exterior buttresses, but not the slightest flexure has ever taken place. The church is built truly east and west. The entrance to both chapels is by two portals. The only modification the exterior of the building has sustained since St. Louis's time is the addition of a little oratory attributed to Louis XI, and the rebuilding of a part of the façade in the fifteenth century.

The porch of the lower chapel is divided into two bays by a pier, on which is a statue of the Blessed Virgin, while above in the tympanum is a Coronation of the Virgin. This and the entire ornament of the doorway is the work of M. Geoffrey Dechaume. The original statue had the reputation of working miracles; and it is related that when, towards 1304, Jean Duns Scot, a celebrated theologian of the University of Paris, was praying at its feet, it bent its head in approval of the doctrine of the Immaculate Conception, which that learned doctor taught, and that since that time it always remained in the same position. The portal of the upper chapel is of the same character as the lower one, but richer in its decoration. It is nearly all new, for the old had not only been mutilated, but completely chiselled off. The subject in the tympanum is "The Last Judgment." The voussoir is a mass of sculptures — single figures, groups, and ornament. The figures are forty-four in number, and complete the central subject: angels conducting the elect to heaven, angels censing and bearing crowns, martyrs with the instruments of their passion, and the damned surrounded by the flames of hell. Happily the sculptor had some old work upon the portals of Notre Dame and St. Germain l'Auserrois to study, and the execution is a marvel of patience and knowledge. Each figure has been fitted into its place upon the lines of the original, wherever any trace was left.

The plan of the church is a parallelogram, terminating in a polygonal apse. The buttresses reach to the parapet, and terminate in pinnacles surrounded by gargoyles, ornamented with the most grotesque beasts. The windows of the nave are divided into four lights, with foliated circles in the heads very similar to those of the chapter-house at Salisbury. The first *flèche* fell in the reign of Charles VI; the second was burnt in the great fire of 16 July, 1630; the third was erected by Louis XIII, in the ogival style of that period, and remained until the seventeenth century. When it was destroyed, in 1791, it contained five bells which had been cast in 1738 — the Dauphin, the Duc d'Orleans, the Duc de Chartres, and the first President of the Chambre des Comptes being their sponsors. The present *flèche* was erected in 1853, and is in the style of the fifteenth century. It is wood covered with lead, and consists of three octagonal stories supporting the spire. On the lower story are colossal statues of the twelve apostles. The St. Thomas is a portrait of the sculptor Lassus. The gables of the upper story support angels with the instruments of the Passion. The crockets of the spire are *fleurs-*

de-lys, and the whole is resplendent with gilding. The summit of the *chevet* is surmounted by a huge angel holding a processional cross. There was an idea, never carried out, of making the statue turn round mechanically upon a pivot during the twenty-four hours, that it might present the symbol of salvation successively to all quarters of the city. The statues are all portraits — so, too, are the masks — the portraits of the artists and workmen engaged on the work of restoration. The oratory erected by Louis XI, between the two buttresses of the fourth bay on the south side, is easily distinguished from the thirteenth-century work.

The vaulting of the lower chapel is supported by fourteen columns. At the east end is a *chevet*. The bosses are of wood. The two columns without capitals were added at the same time as the apsidal tribune in the upper chapel. The decoration is in imitation of the original thirteenth-century work. In removing the remains of some later work in a style utterly at variance with the architecture, by Martin Fréminet, painter to Henri IV and Louis XIII, a little of the original painting was discovered. This is a fragment of an Annunciation. In 1691 the tracery of the windows and the stained-glass were destroyed and replaced by white, to give extra light. The pavement is a mass of inscriptions, almost the only ones which exist at present at Paris; but the whole floor is laid with mattings, so that it is impossible to study them. Formerly there were seven altars and a font in the lower chapel, and Boileau, whose father had a house in the court of the palace, was baptized there in 1636.

The upper chapel is one of those buildings which one never tires of admiring. When we wind our way up the turret stairs, and enter it from semi-darkness, it strikes us as the most exquisite blaze of color imaginable. Add to the beauty of the chapel all the associations which crowd upon one's memory — St. Louis's beautiful faith and noble life, his enthusiasm for God's work and man's welfare, all the ceremonies and processions, the lights, the flowers and the incense — and one's imagination forms a picture that no hand could adequately paint. The chapel is composed of four bays for the nave, and seven smaller for the apse. The vault is groined and is supported by clustered columns; the capitals are ornamented with foliage. The windows occupy the entire space between the supporting columns, and are filled with most beautiful stained-glass, while below them is an arcade supported by a stone seat. The capitals of the columns are most exquisitely carved in imitation of the flora of France; the quatrefoils between the arches being filled with a kind of decoration which is as rare as it is effective. The designs were drawn upon the stone, and the backgrounds filled in with incrustations of blue glass and gold. The subjects are taken from the lives of the martyrs. Most of them have been restored; but very wisely, two or three have been left in the state in which they were discovered. Between the arches of the arcade are angels with outstretched arms, who seem to be crowning the martyrs in the quatrefoils. At the third bay of the nave on each side are recesses which formed reserved places for some privileged persons during mass; and it is thought that they were probably occupied by the king and queen — the former on the gospel, the latter on the epistle side. On the south wall is a slanting recess, which formerly must have served as a chapel, as there was an altar at the end of it, having a painted reredos representing the interior of the great *chasse* with all its contents ranged in proper order, and St. Louis praying before it. It is supposed that Louis XI may have used this niche as a place where he could pray, and see the altar and relics, without being seen himself.

It was always the custom, at the consecration of a church, to place a cross wherever the sign of the cross had been made by the bishop. The architect of the Sainte-Chapelle conceived the happy idea of placing the twelve Apostles as pillars of the church, supporting these crosses, which are in the form of monstrances. The pedestals on which the figures stand are affixed to the pillars. The statues, like the entire church, are painted and gilt, and those of the thirteenth-century are marvellous examples of the sculpture of that period. After the closing of the chapel, these statues were sent to the Musée des Monuments Français; but when the Museum was suppressed, they were dispersed or broken up. St. Peter was discovered in fragments in St. Denis; another was given to the church at Creteil, where it passed as St. Louis; four were given to the missionaries, for their Calvary at Mt. Valérien. These were in perfect preservation and the color had not disappeared. They remained at the entrance of one of the chapels of the Way of the Cross until 1830, when some senseless vandals threw them down and broke them. All the fragments that remained are now in the garden of the Hotel Cluny, a "museum of fragments." The rest were replaced in the chapel, and are the fourth and fifth on each side facing the altar. The others are new.

The pavement is modern incised stone, with crustations of color, and representing geometrical patterns, animals and flowers. In the apse are subjects, the four rivers of Paradise and the seven sacraments in the form of rivers. The altar is an exact copy of the original one. Above it is the tribune and canopy where the relics were exposed, with a spiral staircase leading up to it; the northern one is ancient, and was found by Alexander Lemoine in the Musée des Petits-Augustins, where for half a century it had been attached to the façade of the château de Gaillon, a sixteenth-century work now in the court of the École des Beaux-Arts. But we are not allowed to think of St. Louis mounting these steps, for they must be placed amongst the additions at the end of the thirteenth century. On one side of the apse is a very beautiful piscina. Part of the baldacchino is the original, and the rest has been restored from old drawings.

Formerly several statues occupied places in the chapel: one a terra-cotta Notre Dame de Pitié, by Germain Pilon, which is now in the chapel of the military school of St. Cyr. A sixteenth-century *jubé*, with altars attached to it, marked the nave from the chancel. The retables of these altars (now in the Louvre) were in enamel, signed and dated Léonard Limousin, 1533, and contain portraits of François I and his second wife, Eléonore d'Autriche, sister of Charles V, and of Henri II and Catherine de Medicis, all kneeling. The choir was filled with carved stalls of the time of Henri II. At the four corners of the altar pavement, Henri III elevated bronze angels upon black marble pillars. On the retro-altar was a silver-gilt model of the chapel, three or four feet high, executed in 1631 by Pijard, *orfévre*, which contained some of the relics. It was considered a very fine work of art and cost 13,000 livres. There is an excellent drawing of the original altar in Viollet-le-Duc's dictionary. Canon Moraud tells us, in his history of the chapel, that the ciborium, which is usually placed in the tabernacle, was here suspended in a cross over the altar — probably on the retro-altar, as in the engraving of the high altar in the canon's book there is no representation of it. All the furniture of the church has disappeared.

St. Louis ordained, in his foundation charters, that the offerings received by the priests at the altar should be devoted to the reparation of the glass, and that if it should not be sufficient, the necessary funds should be taken from the Trésor Royal deposited at the Temple. The restoration of the windows is now complete, and was the work of MM. Steinheil and Lusson. These artists have done their work so well, and matched the colors so perfectly, that it is difficult to distinguish the new from the old. The rose-window is of the fifteenth century, the others thirteenth century. The subjects are from the Old and New Testament, and from the life of St. Louis. Some of these latter are original. As it is probable that the artists assisted at these ceremonies, it is also possible that the pictures may be true portraits of the personages represented. The subjects of the rose-window are all taken from the Apocalypse. S. BEALE.

SOCIETIES

BUFFALO SOCIETY OF ARCHITECTS.

AT an adjourned meeting of this society, held October 19, the following officers were elected for the present year: *President*, Cyrus K. Poeter; *First Vice-President*, Geo. J. Metzger; *Second Vice-President*, L. Bethune; *Secretary*, W. W. Carlin; *Treasurer*, R. A. Bethune. Paper for next meeting (November 2) on "When and by Whom was the Arch Invented," by Mr. J. R. Poeter. Question for discussion, "Birch." W. W. CARLIN, *Secretary*.

COMMUNICATIONS

PALLADIO'S FIVE ORDERS.

CHARLESTON, S. C., October 20, 1886.

TO THE EDITORS OF THE AMERICAN ARCHITECT: —

Dear Sirs, — Please inform me in your next issue, or by mail, what price would buy the following work: "*A Short Treatise of the Five Orders*," and other matters, by A. Palladio. London, 1721. Published by John Darby. Plates by John Vantack. Four volumes in two books. I can get the first volume (only one volume) and want some idea of the value of same. An early answer will greatly oblige,

Yours respectfully, E. B. RUTLEDGE.

[B. T. BATSFORD's catalogue quotes the price at 18 shillings and 6 pence. — EDS. AMERICAN ARCHITECT.]

MATERIAL FOR ROUGH-CASTING.

NEW YORK, October 22, 1886.

TO THE EDITORS OF THE AMERICAN ARCHITECT: —

Dear Sirs, — Will you please inform me through your paper what material is best suited for rough casting with half timber work, the rough cast to be done on brick work; also whether it can be colored in the mass, or painted after being applied.

I am yours truly, E. HADDEN.

[CEMENT, either Rosendale or Portland, is the only material that can be depended upon with any certainty to stay on brickwork. Sawdust mixed with the cement is said to make it hold more firmly. The cement can be colored in the mass with any mineral color not affected by the cement. In our experience, however, the color in the mass seems to encourage a slight efflorescence which injures its effect, and it is necessary to be prepared for a little disappointment. Painting on the surface is easier and neater than the other method, but less durable. — EDS. AMERICAN ARCHITECT.]

NOTES AND CLIPPINGS

Ignition by heated Steam-pipes.—With each recurring fall and winter the question of the possibility of fires from steam-pipes becomes one of importance. As the most insidious diseases are usually most to be feared, so the most occult causes of fire are among those which should be most carefully looked after. The apparent paradox of steam —the vapor of water—heating iron to such an extent that it will produce ignition in a contiguous combustible substance, is, of course, hard, perhaps impossible to understand. Had not suspicious circumstances directed inquiry toward this cause, it is likely that the possibility of fires from this source would never have been thought of. The *London Fireman* thinks that the most successful attempt at a reconciliation of the apparent inconsistency of scientific fact with practical experience yet made public is contained in a recent article in *Glaser's Annalen*. The writer, it believes, has arrived at a correct solution of the difficulty. It is very well known that wood, after remaining for some time in contact with steam, hot-air, or hot-water pipes, becomes carbonized on the surface, and to a short distance below. The charcoal, of course, readily oxidizes. When steam is not in the pipes the charcoal will absorb moisture. When again heated the moisture is driven out, leaving a vacuum, into which the fresh-air current, circulating around the pipes, readily penetrates. It imparts oxygen to the charcoal, causes a more rapid rise in the temperature, till finally the point of ignition is reached. The rusting of the pipes, if it occurs, might also conduce to the same result, the rust being reduced by the heat of the steam to a condition in which it will absorb oxygen to the point of red heat.—*The Investigator.*

The Origin of Cyclones.—In a recent paper on the "Conservation of Energy in the Atmosphere," Dr. Werner Siemens gives the following theory of the origin of cyclones: The comparative vacuum formed at the centre of a cyclone can produce suction only in the direction of the axis of the cyclone, thus either raising the water upon the surface over which it rotates, or drawing down air from the higher regions of the atmosphere. The existence of such a descending current of air within a tornado is confirmed by the clear sky and quiet air often observed at its centre. We must imagine, says Dr. Siemens, a local cyclone as produced by an impulse of superheated air, due to some local cause or other, given at the boundaries of an upper and lower tract of disturbance of the neutral equilibrium of an atmosphere at rest, which reaches the boundary of the upper cooled strata of air, which have a tendency to descend. We must thus have an outer descending current formed round the ascending one, by means of which as much air descends as has been carried up by the ascending current. If the disturbance of equilibrium embraces extended upper and lower strata of air, the descending masses will produce an increase of pressure in the neighborhood of the cyclone, gradually extending to the surface of the earth, and on the other hand into the highest regions of the air, and transfer its *vis viva* continually into new superheated masses of air which ascend in the cyclone, whilst a part of the descending external cyclone circulating in the same direction, ascends again with the inner, and transfers to it a part of the *vis viva* gained in the higher regions of the air. The course of the centre of the cyclone is then determined by the direction of the mean velocity of all the air masses forming the cyclone, and its duration is that of the disturbance of the neutral equilibrium of the atmosphere which called it forth and maintains it. The local ascending current, by carrying dust and particles with it, may also produce rain by condensing the aqueous vapor of the higher strata.—*Engineering.*

Puddling Clay.—It is stated in the *Aberdeen Free Press* that Mr. Thomas Fraser, of King Street, Aberdeen, has discovered a new method of preparing clay for preventing leakage in reservoirs, water-tanks, etc., and has taken the necessary steps to have his invention patented. Hitherto it has been the general practice, when clay has been used in connection with the construction of water-works, and for other similar purposes, to apply it in a thoroughly wet and plastic condition. From a series of scientifically-conducted experiments, Mr. Fraser has come to the conclusion that far better results can be obtained by drying the clay, and reducing it to a fine powder, before applying it to the bed of a reservoir or to anything which it is desired to render water-tight. A long connection with the brick and tile business led him to study closely the properties of clay, especially when used as a preparation out of which a variety of articles had to be manufactered. He learned from observation that in a wet state clay had reached its extreme point of expansion, and that water would then filter through it. Having ascertained this fact, he concluded that if clay were used for puddling in a dry, compressed state it would absorb a certain percentage of water, expansion naturally following, and rendering the layer water-tight. The greater the pressure of water the more satisfactory the results are said to be. Mr. Fraser began his experiments by selecting his clay from a special bed, out of which he cut a square. The specimen was carefully measured and weighed. After it was thoroughly dried, its dimensions and weight were again taken, when it was found that the clay had lost 25 per cent in weight, while the shrinkage was 10 per cent. Clay in this dry state is extremely hard and compact, and if put into water and not allowed to expand, it would require a long time before water would penetrate to the centre of a 3 inch tube. Another specimen of clay, from the same bed as the former one, was dried and reduced to a fine powder. In this loose condition it absorbed about 75 per cent of the water, which filtered through it. When the clay was prevented from expanding, it was found to absorb 50 per cent of water, which filtered a little. Powdered clay to the depth of 6 inches was pressed into a tube 8 feet long by 3 inches in diameter, and having 2 inches of perforated zinc at the bottom. The tube was then filled with water, with the result that the clay absorbed 35 per cent, but there were no traces of filtration. Mr. Fraser is confident that the method he has hit upon, besides being more efficient, is also more economical in every way than the manner of using puddled clay now in vogue. He is sanguine that it could be beneficially applied in covering arches, in preparing a perfect bed for street causewaying, or, in fact, for the prevention of leakage in any description of work that has to be made waterproof from internal or external pressure.

TRADE SURVEYS

The conclusions arrived at by writers of financial business articles in many of our daily papers throughout the country, are that industrial and commercial activity, which set in early in September, will, in all probability, continue throughout the winter. The opinions of the authorities in building interests are to the effect that the winter building perhaps will be more extended than it was last winter. The views of leading railway authorities are that more railway mileage will be built during the next six months than was built during the last season. The views expressed under serial statistics are that we will shortly have an improving trade in spite of the fact that the surplus serial supplies are larger than last year. Their opinion is that with this larger stock prices would improve. They give as a reason that the demand and consumptive requirements are greater this year, and nothing greater than the increased supply to testify their opinion of higher prices. Our leading machinists throughout the New England and Middle States have recently expressed the opinion that the demand in machinery during the next six or twelve months will so far exceed the demand of the past like periods as to allow a very satisfactory increase in the margins on the work. They say, though it looks as if it were mere guess-work, that there will be no labor troubles this winter, and that the improving demand will allow for wider margins. In a few specific cases contracts have been placed for railway, mining and agricultural machinery, and for machinery for textile and rolling mills, which certainly warrant the conclusions above referred to, that prices will be better. As far as organized labor is concerned, the opinions entertained by leading employers, manufacturers, and managers of our large industrial and railroad enterprises are probably correct that there will be a vast amount of preparatory work done in general. The high bidding in machinery building and in railroad work is a fact which is apparent to all those who have given a moderate degree of attention to these matters. The reason for this active activity in preparation is that there is a widespread feeling that prices for material, and prices in many lines of merchandise will probably advance early in the spring. Orders have been given very largely during the past two or three weeks upon this supposition. Contracts have been made for raw material in its various stages to be delivered along through the winter and spring as wanted. Half raw contracts have been placed by iron and steel makers. The largest wool contracts placed for years have been placed upon the cloth manufacturers. In building circles large contracts have been placed for lumber and even for brick. This unusual procedure is based upon two things, first, the fear of advance in prices, and a certain knowledge that the material wanted by this activity, would at other times produce a speculative advance, and is just now producing a very opposite result. The manufacturers, builders, and others are ordering material at current rates in order that they will not be obliged to pay higher prices later on.

Two or three of the highest railroad authorities in the State, no later than this week, say that their instructions to their agents have been to liberally provide for the full requirements; lumber stocks, iron and steel supplies, and rolling-stock requirements, including cars and locomotives. Some of our best-posted builders in New York, Philadelphia and Chicago, well recognizing the strong undercurrents in trade and industries, have declined to assume the risks involved in making contracts, three or four months sooner than necessary. As before stated, however, there are a few exceptions. These observations cover a general trade and industrial situation. To go into details: the European iron-markets are improving. The iron-markets throughout the United States are stronger this week than they have been for three years. Most of the locomotive works are better sold up than they have been for the same periods in past years. Four works are running nine hours per day. As far as our advices go, every properly-equipped car-works in the United States has all the business in hand that can be safely handled. In the coal interest one advance in anthracite has already been made; another will shortly go into effect. The anthracite productions for November are estimated at $3,500,000. In railroad circles we have the past two weeks between seven hundred and eight hundred miles of new road projected concerning the construction of which there is no doubt whatever. They are short lines of road ranging from twenty to sixty miles, several of these lines are in New York. Pennsylvania and Ohio, and there are indications, if statements can be relied upon, that syndicates are about being permitted by which New York and Boston will be benefited in the development of the trans-Atlantic traffic, which will bind the far West and the Dominion in more intermediate commercial relations with those two States. Great railroad improvements are projected by the leading trunk lines in the near West, by which distances will be shortened, and new regions opened up. All these facts go to substantiate the predictions made by railroad managers, that the coming year will be the most active year in railroad construction ever known. The projected constructions are perfectly legitimate and traffic is waiting for it, instead of as formerly building roads, which must wait for the development of traffic. These facts are referred to in order to analyze the opinions of some of our best building authorities, both in the East and the West, and also to understand the logic of some projectors, which has been customary in the formation of syndicates for large manufacturing propositions, particularly in the West. A great deal of Boston and New York capital has united for the purpose of our industrial propositions on a large scale. In the wake of projected railroad construction the lumber trade has been very active during the past week or two. The window-glass manufacturers are endeavoring to form some sort of a national organization for the double object of maintaining prices and securing better control of labor. The hardware interests are still suffering from bids growing from analogies, but in spite of this, more capital has been invested in hardware manufacturing the past year than in former years. Real estate is improving in a few of the larger cities. Building activity is quite active in New York, Philadelphia and Chicago. It is impossible to obtain satisfactory information from many of the smaller cities, but as far as the scattered replies indicate, there will be a greater activity in house and shop building. At present, building labor is in very urgent demand. Labor of all kinds is employed. A serious lockout is threatened in Philadelphia on November 3. Leaders of labor organizations are more active in their efforts to arbitrate and consolidate than are employers in many cases.